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under the auspices of

Tatiana Čorejová
Rector of the University of Žilina

SECTION 1

TRANSPORT AND COMMUNICATIONS TECHNOLOGY

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TRANSCOM 2015
11th European conference of young researchers and scientists

TRANSCOM 2015, the 11th international conference of young European scientists, postgraduate students and their tutors, 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 scientists 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 incl. natural sciences.

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TRANSCOM 2015, 22-24 June 2015
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Research on Ecological Parameters of Combustion Engines in Non-road Vehicles

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Abstract. The problem of emission of toxic compounds exhaust gas generated by non-road vehicles with internal combustion engines, took on a new meaning thanks to the entry into force on 1 January 2015 year Stage4 standards. The paper presents the study of exhaust aftertreatment systems for medium power diesel engine coming from the agricultural tractor. The tests were performed using AVL BOOST software.

Keywords: means of transport, combustion engines, ecology.

1. Introduction

Global emission limits for mobile heavy-duty diesel engines are becoming increasingly rigid with government emission requirements ultimately requiring never, more sophisticated technologies to meet or exceed regulations [5]. The exhaust gases, have negative impact on human health, as well as on global climate change [6, 8]. The exhaust gases are a mixture of chemical compounds, which are dependent on the type of fuel, engine condition and the equipment applied to reduce the emission [8]. Presently used piston IC engines must be able to generate as small harmful environmental effects as possible, which means that need to produce low exhaust toxicity and noise [1]. Requirements posed for internal combustion engines make it necessary to search for different technical solutions to reduce exhaust emissions, fuel consumption and to improve engine traction properties [2, 9]. The new solutions will require an integrated approach that involves an engine fuel injection system, exhaust after-treatment and an engine control unit system (ECU).

The article addresses the issue of exhaust emissions from non-road vehicles powered by internal combustion engines, which must comply with the requirements of the standard Stage 4, for example, agricultural tractors powered by diesel engine medium power. The research team is involved in the adjustment of exhaust gas cleaning system for agricultural tractor engines adapted to burn petroleum fuels and biofuels. This paper presents a computer simulation study of functioning depollution standard with an aftertreatment system diesel engine using AVL BOOST software.

1.1. New ecological standards

Nitrogen oxides (NOx), hydrocarbons (HC), particulate matter (PM) and carbon dioxide (CO2) are most important regulated diesel emissions components. The legislation is driving for the use of renewable fuels in combustion engines but all the impacts of those on emission control technology are not clear yet. One of the challenges in diesel engines is the simultaneous removal of NOx and PM, because the technique for reducing one component may lead to an increase in another. One solution is to use selective catalytic reduction (SCR) technology and to optimize the combustion conditions in the engine in such a way that leads to the reduction of particle emissions and fuel consumption [5]. In the SCR technology a large amount of NOx emissions are reduced by using a

catalytic converter and urea solution. Conventionally in the SCR applications for both stationary and transient emission sources vanadium-based catalysts are used [3] and [4].

Figure 1 shows the applicable emission standards for non-road vehicles due to the achievable power of diesel combustion engines.

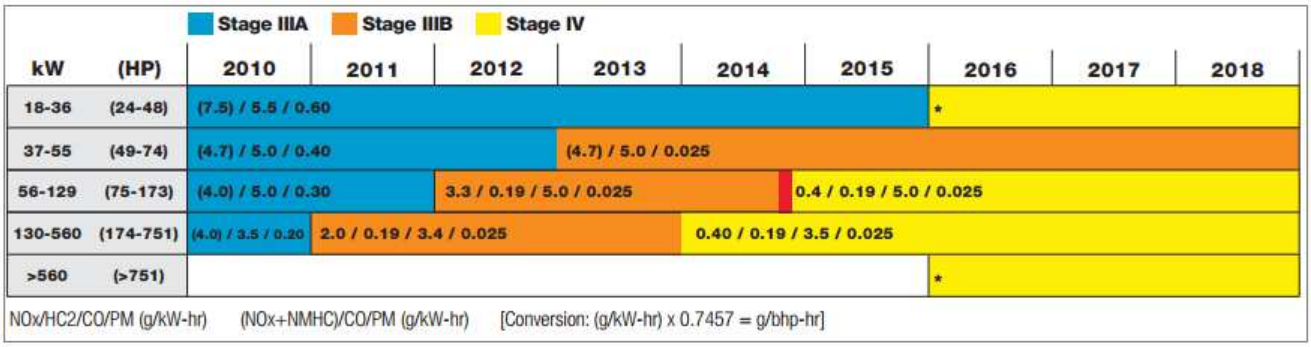

Fig. 1. The applicable emission standards for non-road vehicles [10].

2. Research object

2.1. Test stand

In order to identify opportunities to reduce the amount of toxic gases emitted by the diesel combustion engine were carried out tests on the dynamometer stand. The object of the study was the engine PERKINS 1104D-44TA installed in agricultural tractors URSUS brand. This engine has a maximum power of 83 kW at crankshaft speed 2200 rpm. It is also equipped with a turbocharger and intercooler. Basic technical parameters of the engine are presented in Table no. 1.

General data	Data
Displacement	4.4 liters
Bore	105 mm
Stroke	127 mm
Compression ratio	16,2 : 1
Power/rotational speed	83 kW/2200 rpm
Peak Torque at rotational speed	418 Nm at 1400 rpm
Combustion system	Direct injection
Aspiration	Turbocharged (air-to-air charge cooled)
Fuel	ON

Tab. 1. PERKINS 1104D-44TA engine specification [7].

The control of fuel dosages in test engine is done mechanically. This engine does not have an exhaust aftertreatment system. In order to perform measurements of toxicity of exhaust the engine has been installed on dynamometric test bench with electro-vortex brake Schenck 130W. Detailed analysis of the composition of the exhaust gas was carried out by Fourier Transform Spectrometer (FTIR).

2.2. AVL modeling system of diesel engine exhaust emissions

In the first phase of research was estimated the load characteristics of engine being the object of tests. Measurements were carried out for five torque values at crankshaft speed of 2200 rpm. Simultaneously was carried out measurement of fuel consumption and emissions. The results of the research were used for modelling using AVL BOOST software. BOOST is an advanced and fully integrated "Virtual Engine Simulation Tool" with advanced models for accurately predicting engine performance, acoustics and the effectiveness of exhaust gas after treatment devices [11].

With the assistance of Boost software has been created the emission control system consisting of two modules: diesel oxidation catalyst DOC and catalyst with selective catalytic reduction SCR. The scheme of this model was shown in figure 2.

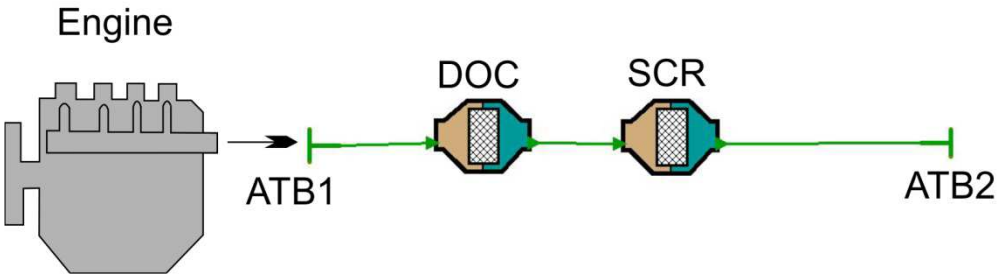

Fig. 2. Model of aftertreatment system; ATB1, ATB2 – boundary conditions; DOC – diesel oxidation catalyst; SCR – catalyst with selective catalytic reduction.

The degree of conversion was calculated from the formula:

$$\alpha = \frac{n_{before} - n_{after}}{n_{before}} \cdot 100\% . \qquad (1)$$

where:
α – degree of conversion;
n_{before} – the initial amount of substance (before catalyst);
n_{after} – the final amount of substance (after catalyst).

Figure 3 shows an influence of change of the excess-air ratio on load and the specific fuel consumption.

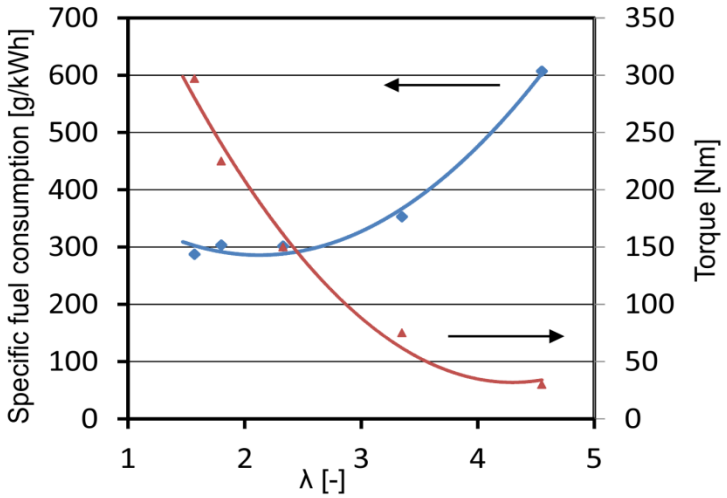

Fig. 3. Specific fuel consumption and Torque with respect to air excess ratio (λ).

Minimum specific fuel consumption achieved with a coefficient of λ= 1,57.

The exhaust temperature and exhaust stream with respect to air excess ratio (λ) was shown in figure 4.

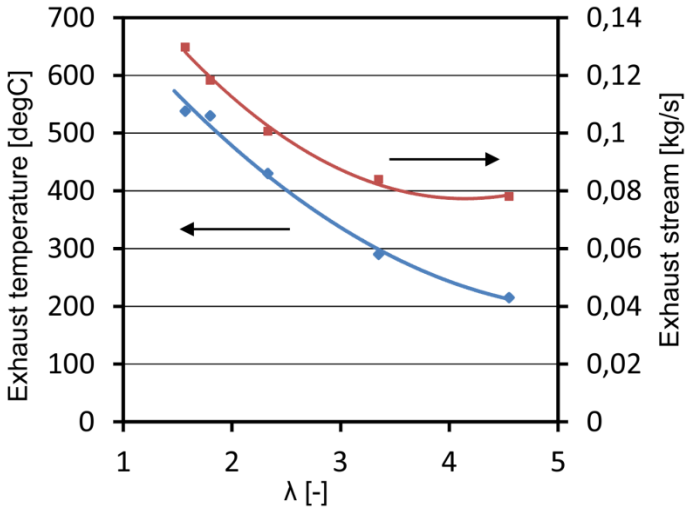

Fig. 4. Exhaust temperature and exhaust stream with respect to air excess ratio (λ).

Important figures from the point of view of emission control system is the flow of the exhaust gases and their temperature. Optimum operating temperature of SCR system shall be within approximately from 250 to 500°C. When measuring the temperature of the gases obtained from 215 to 538 °C, and thus obtained optimal conditions.

Figure 5 shows emissions of oxides of nitrogen (NO_X) obtained during the test bench (blue) and the results of the calculations of the reduced emissions after the implementation of SCR system (red).

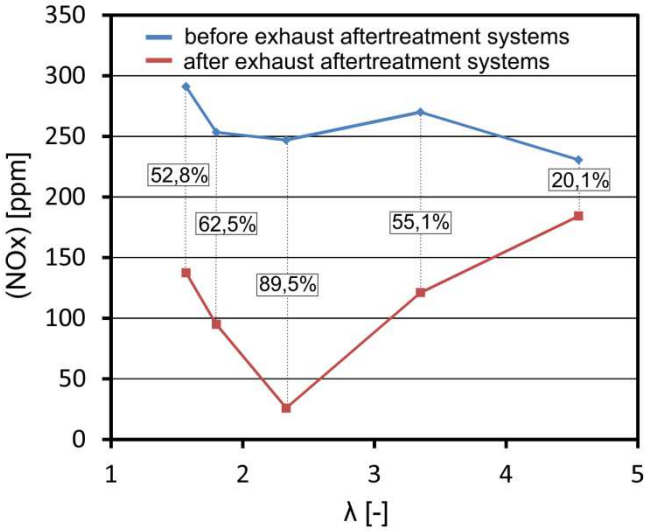

Fig. 5. NO_X emissions with respect to air excess ratio (λ).

By analysing the results obtained, it can be observed that most efficiently modelled emission control system operates at medium rates of excess air. For λ = 2,33 was obtained the reduction of NO_X from the value of 247 ppm to approx. 25 ppm. For low loads and low temperature of exhaust gases were obtained low values of the conversion level. It should be noted that such a work of selective emission control system can be linked to a significant ammonia emissions. In the engine power rating also there was a significant decrease in the catalytic efficiency. In this rating has been observed an interesting phenomenon involving the production of oxides of nitrogen by oxidation reactor.

In the figure 6 presents HC emissions with respect to air excess ratio (λ).

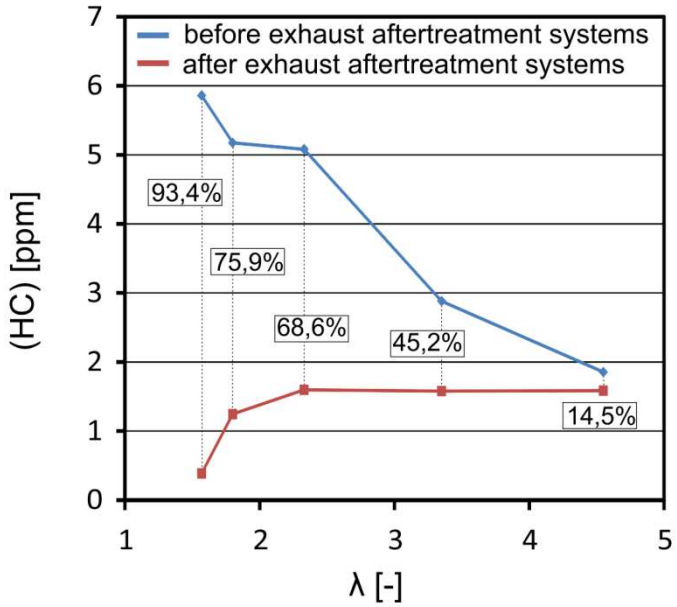

Fig. 6. HC emissions with respect to air excess ratio (λ).

Hydrocarbon conversion efficiency strongly depends on the load on the engine, and thus, exhaust gas temperature. At the maximum test load and λ = 1.57 conversion of hydrocarbons was 93,4 %. It is to be noted that the observed concentrations of hydrocarbons were extremely small.

The figure 7 presents CO emissions with respect to air excess ratio (λ).

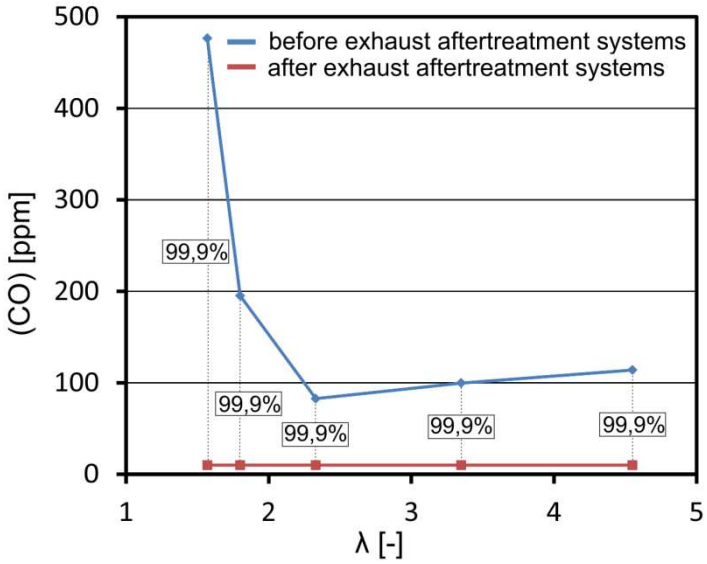

Fig. 7. CO emissions with respect to air excess ratio (λ).

Because the temperature light-off (50 % of conversion) of carbon monoxide is much lower than temperature of hydrocarbons conversion, even at low loads is obtained almost complete oxidation of CO.

3. Conclusion

From 1 January 2015 are in force new standards for stage 4 concerning emissions toxic compounds by non-roads vehicles including agricultural tractors fuelled with diesel combustion engines. Legislative changes in new areas of exploitation including non-road vehicles, require from the constructors searching for ways to adapt and modernise selective catalytic reduction system in

combustion engines of these machines. In this paper the authors have focused on model and experimental research of combustion engine in medium power agricultural tractor.

As a conclusion, the use of the SCR converter decreased the number of particles in general but increased the number of the nanoparticles. The fuel type have a great impact on the number and chemical composition of particles emitted from the non-road vehicle with diesel engine. For this reasons the new solutions will require an integrated approach that involves an engine fuel injection system, exhaust after-treatment and an ECU, etc.

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The Study of Wear During Diesel Engine Start-up

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Abstract. The start-up of the combustion engine is necessary to the occurrence of other phases of its operation occurring when its crankshaft rotates. Therefore the engine start-up seems to be the most important functional state in engine operation. This paper presents the studies on the wear during start-up engine process and some results of investigation its wear.

Keywords: Combustion engine, start-up, wear of liner cylinder.

1. Introduction

Start-up of the engine is necessary to the occurrence of other phases of operation of internal combustion vehicle engine occurring when its crankshaft rotates. The start-up of the car engine is a process, during which the engine is taken from rest to a state of independent action by providing energy from the outside and forcing its internal work processes [3,6]. Therefore the engine start-up seems to be the most important functional state in its operation. Due to unfavorable physical processes that take place during engine start-up, there are an increased emission of toxic compounds of exhaust gas and the high noise level and the overloads in the vehicle electric power system [8,12]. We can also observe many negative tribological processes in selected tribological engine units. The extent of such negative processes depends on engine start-up parameters: the temperature and the time of the engine start-up, the value of current consumed by a starter etc. [3].

The scope of problems concerning the diesel engine start-up is very extensive and complex. This paper presents the studies on the wear during start-up engine process and some results of investigation its wear.

2. Friction and wear processes during diesel engine start-up

Transition from the standstill to the movement of the components and units of the diesel engine demands delivery of external mechanical energy required to overcome static friction forces during its start-up. These forces counteract the movement of the surface elements that contact with each other. When external forces are applied then occurs, with no slippage in macroscopic scale, shift (micro-slip) within the contact surface. This is accompanied by elastic-plastic deformation of the surface layers of elements [9]. Transition at the engine start-up from the standstill to the movement of the diesel engine causes that the value of the observed engine start-up anti-torque decreases significantly with respect to the resistance torque derived from the static friction [11].

Boundary friction occurs at the beginning of engine start-up. This friction is the result of the lack of sufficient amount of engine oil and occurring too low relative speed of the moving surfaces of the tribological pairs [1,3,9,11], causing by the lubricant film having a thickness from a few to several tens of molecules covering surfaces of cooperating elements.

This lack of sufficient amount of engine oil is caused primarily by inertia of the engine lubrication system. The figure 1 presents a course of changes in the engine oil pressure measured on the main oil line during 4CT90 diesel engine start-up at the temperature 15 °C.

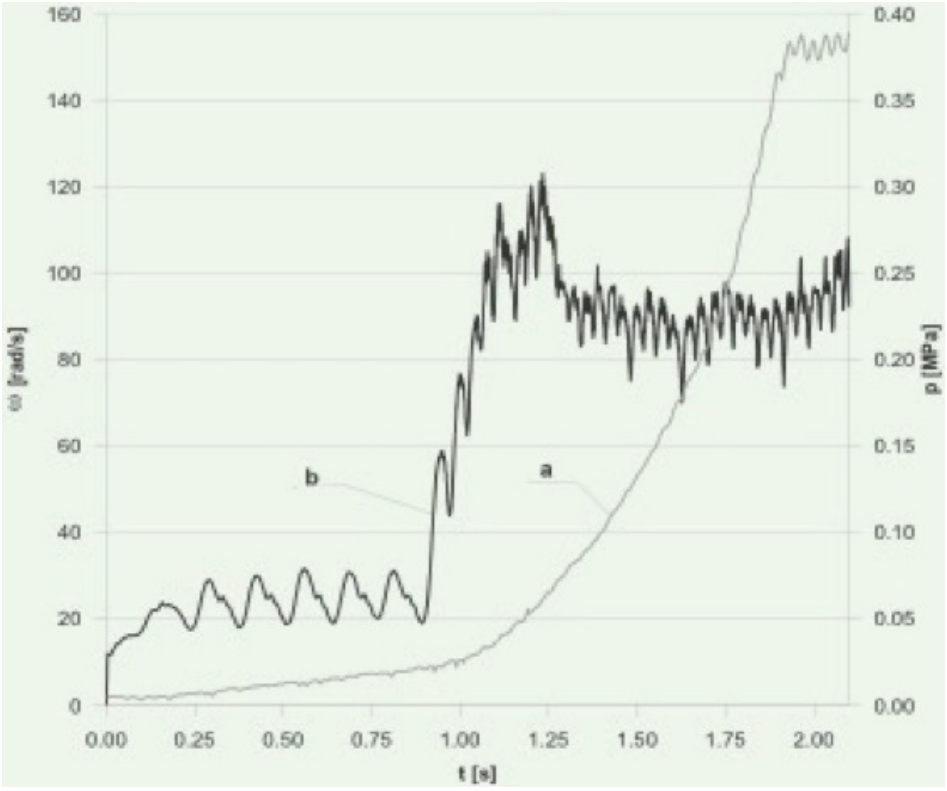

Fig. 1. The course of lubricating oil pressure changes and crankshaft angular velocity at 4CT90 diesel engine start-up at 15 °C; a – the course of oil pressure, b – crankshaft angular velocity [4].

For the engine start-ups above in the temperature 0 °C faster increase and greater value of ”stable” lubricating oil pressure are observed [9]. For the diesel engine start-ups below 0 °C the time when the lubricating oil pressure reaches a stable value in the main oil line increases along with drop in temperature values.

This is due to the high value of oil viscosity and precipitation of sludge in the engine sump (effects of impacts of water contained in oil), which by blocking oil engine lines, increases additionally resistance. The water accumulated in the sump also causes coagulation and hydrolysis of the lubricating oil inhibitors aggravating its lubrication properties [3,9].

A systematic loss of engine oil boundary film on the surfaces of kinematic elements pairs occur during long standstill in engine operation. The permanent boundary oil engine film on cylinder liner sliding surface lasts approximately 48 hours from the time when engine is stopped [3]. This border film disappearance in connection with the lack of sufficient lubrication oil contributes to the possibility of appearance of dry fiction at the beginning of start-up, and therefore to increase the engine start-up anti-torque.

During the start-up, as engine oil flows to tribological parts, observed border friction starts to transform into mixed friction. This contributes to a fall in the value of start-up anti-torque. However, only achievement of a sufficient relative speed, with the appropriate amount of oil lubrication, between moving surfaces of kinematic pairs causes favourable conditions to occur liquid friction [9,11].

The transition from the boundary friction (in extreme cases of dry friction) to mixed friction with a small percentage of fluid friction contributes to the fact that adhesive, abrasive corrosive wear occur in tribological pairs of PRC (piston-rings-cylinder) system at the start-up [1,5,7]. Therefore the values wear of PRC system elements during start-up are several times greater those observed during engine operating in vehicle or stand tests [3,5].

The cylinder liner start-up wear of diesel engine is equal to the sum of two consecutive wear processes, as shown in the diagram in Figure 2.

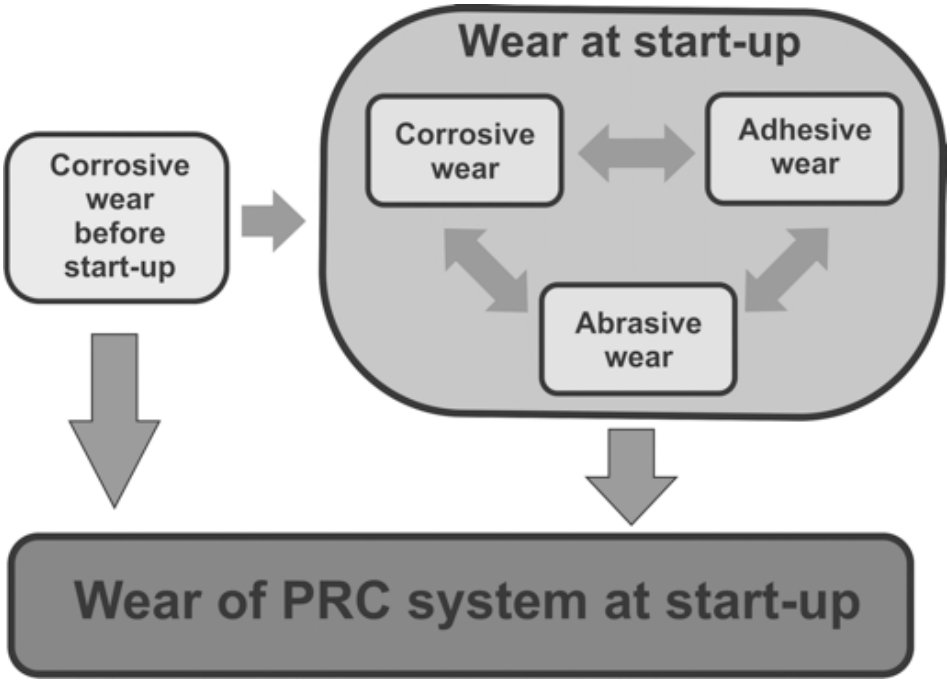

Fig. 2. The diagram of wear of PRC system at start-up [4].

The first process is associated with corrosive wear and it occurs during engine standstill after the engine is stopped. The second process occurs in PRC system during the engine start-up and it is a sum of three wear types: corrosion, adhesion and abrasion. The corrosion of PRC system wear [3,10] observed at the start-up of diesel engine is particularly acute in low ambient temperatures. This is due to the presence of suitable conditions for the condensation of water vapour on the cold surfaces of combustion chamber due to the increase of value of its temperature during the load compression process.

The incomplete and non-complete combustion of air-fuel mixture at the beginning of start-up conducts to form sulphur dioxide, which is absorbed by a thin film of oil present on the cylinder walls. As a result of combination of sulphur dioxide and condensed water vapour is formed sulphuric acid. As good electrolyte it causes electrochemical corrosion of cylinders surfaces.

Second type of observed wear in diesel engine start-up is an adhesive wear. This type of wear is caused by breaking existing micro butt joints of cover layers at the beginning of relative motion. Additionally, adhesive wear can occur in the subsequent part of start-up at a low angular velocity of the crankshaft and high surface pressures in conditions of insufficient lubrication of PRC system elements [3,9].

Abrasive wear occurring during start-up is caused by direct contact between the mating surfaces of PRC system elements, and the presence of loose abrasive particles. These particles are the products of corrosive wear, the initial adhesive wear, as well as contaminants getting into combustion chamber with insufficiently filtered air [9].

The intensity of wear of PRC system elements decreases and sets at a subsidiary level of combustion engine operation [9]. The stabilization of wear speed value comes after removal of micro roughness of mating surfaces. The process of wear rate changing of PRC system elements is called run-in engine after start-up [9,10].

The wear of cylinder liner sliding surface at one start-up of diesel engine is the bigger that the general maintenance wear. Exampling figure 3 (based on own research) presents the wear of cylinder liner sliding surface of a diesel engine obtained in the course of maintenance and laboratory research [3,5].

Analyzing the figure 3 we can say that the average equivalent start-up wear of cylinder liner after 1000 start-ups at 18 °C corresponds with its average wear after 200 hours of engine operation on laboratory tests. The average liner start-up wear after 1000 start-ups at 35 °C corresponds to the average wear after vehicle mileage of approximately 10 000 kilometers.

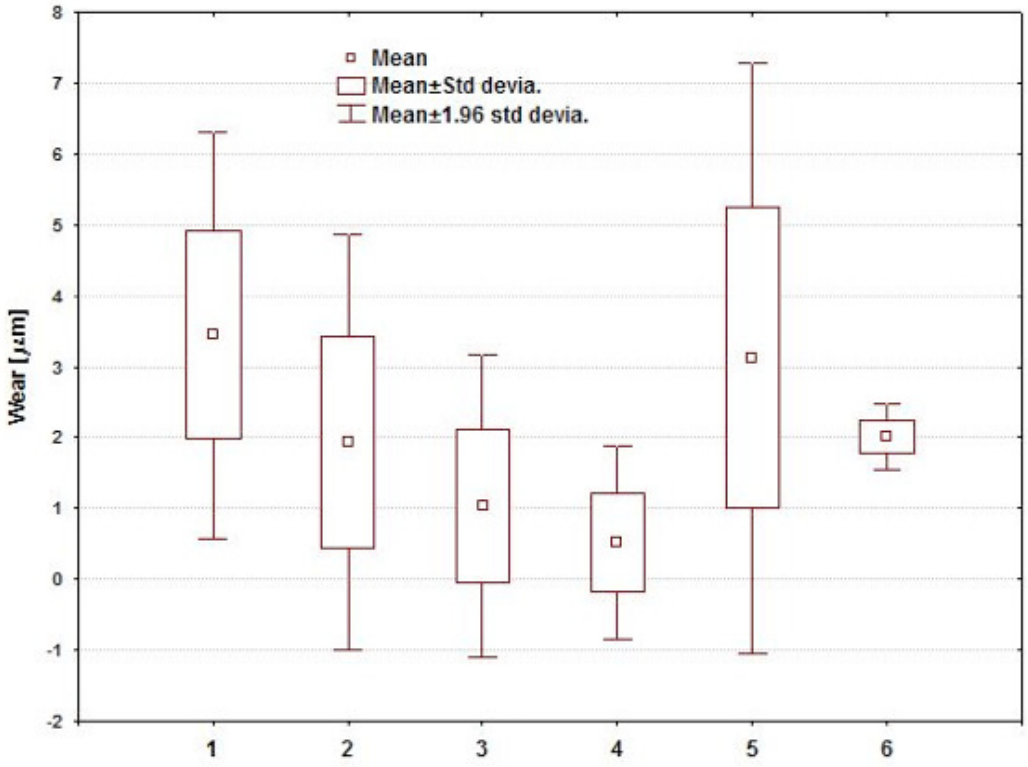

Fig. 3. The categorized graphs of 4CT90 engine liner wear depending on the type of research; 1 – series 1000 start-ups at 18 °C, 2 – series 1000 start-ups at 35 °C, 3 – series 1000 start-ups at 55 °C, 4 – series 1000 start-ups at 75 °C, 5 – 200 hours engine work on test rig, 5 – 10 thousand km mileage [5].

3. Conclusion

Based on the analysis shown in this paper the following conclusions can be drawn:

1. Wear, which occurred during engines start-up, is very complex process.
2. We can observe three types of wear: corrosion, adhesive and abrasive.
3. The wear at one start-up of diesel engine is from 15% to 75% of the general maintenance wear.
4. We must conduct tribological research during diesel engine start-up.

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Prototype of the fastening system for a motorcycle during transport

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Abstract. Providing stability and security plays an important role while transporting motorcycles. Solutions available on the market do not satisfy such requirements in all situations, as well as the requirement for quick assembly and disassembly of the motorcycle. The study presents an original fastening system solution for motorcycles during transport.

Keywords: motorcycle fastening, motorcycle transport.

1. Introduction

In the past few years, sales of motorcycles in Poland, both in the primary and secondary market, increased by several percent. It also connected with the development of motorsports in our country. Therefore, there is a need for the transport of motorcycles. Manufacturers of motorcycle accessories, meeting the demand of the market, present different methods of securing the motorcycle during transport. The optimal method of fastening a motorcycle saves valuable time and energy of the user. At the same time a fastening must secure a motorcycle, in a way that allows easy transport.

Transporting brand new as well used motorcycles, is connected with meeting some basic conditions associated also with the type of a motorcycle. A basic problem is the stability because the motorcycle cannot move or tilt in either direction during transport. It is not practicable to transport the motorcycle in a different position than natural. By the natural position one should understand positions in which a motorcycle is standing upright on the wheels, or is vertically secured in the respective holders.

The concept of stability is related to security. The mode of transport must not threaten other road users, the other transported motorcycles, as well as the bike itself. Damage of load is not permissible during transport. An additional requirement that must be met in transporting a motorcycle is:

- protection against weather conditions,
- preventing damage to the motorcycle traction components (tires, wheels, suspension system, frame),
- protection of the environment against adverse effects of operating fluid, such as engine oil, fuel or coolant,
- time, energy, and the number of people needed to secure the motorcycle during transport.

The solutions used for the transportation of motorcycles can be divided into transporting brand new and used motorcycles. Additionally, one should pay attention to the nature and purpose of the motorcycle - this makes it possible to select the right security system.

Brand new motorcycles, during transport from the factory to the dealer, are protected by the manufacturer. It is a special structure framework, metal box. Inside there are special holders and a rack for the motorcycle. The purpose of this package is to protect the goods against damage and movement.

During individual transport of used motorcycles, many different solutions for the fastening of a motorcycle may be used. A common solution is fastening by means of transport straps. A

motorcycle must be set in a natural position. Another way to quickly fasten the motorcycle is to use a special rack, which consists of a gutter enclosing a tire of the front wheel. Risk Racing promotes Lock-n-Load solution. It is designed to transport Cross/Enduro motorcycles. In this case components of the motorcycle were used - the driver's foot - as the direct element by which a motorcycle is fastened [1].

2. Motorcycle fastening system

The existing transport systems for motorcycles do not meet all the requirements of the users. Creating a new fastening, basic needs of users were identified, which include:

- quick fastening of the motorcycle,
- fastening the motorcycle by just one person,
- simple design and low energy consumption when in use.

Developed fastening [2] meets the overriding features such as stability or safety of a motorcycle and other road users. The fastening does not require additional motorcycle fastening means. The need of using special guiding gutters and the use of handles stabilising the front wheel is eliminated. As a result, the product can be used on any plane (commercial vehicle floor, trailer platform, etc.) on which we intend to transport the motorcycle. Proposed technical solution of the fastening is shown in Figures 1 and 2.

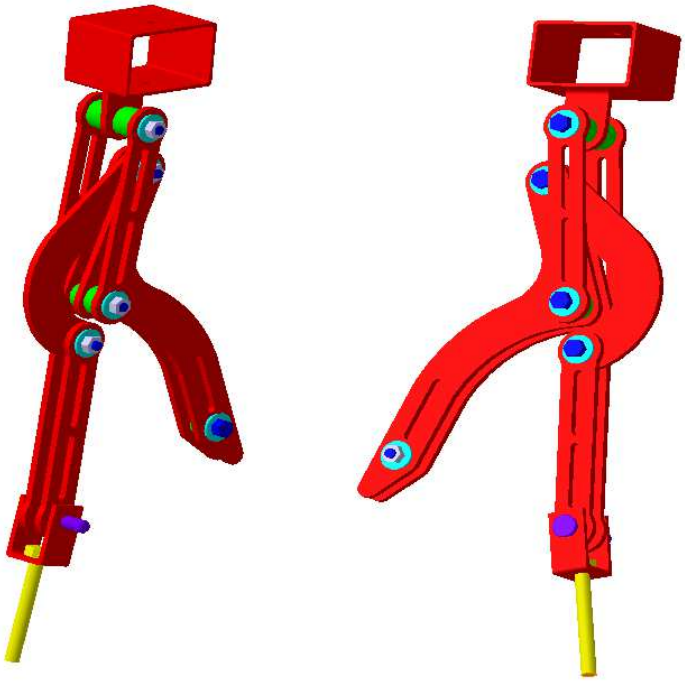

Fig. 1. Fastening type designed using CAD software [2]

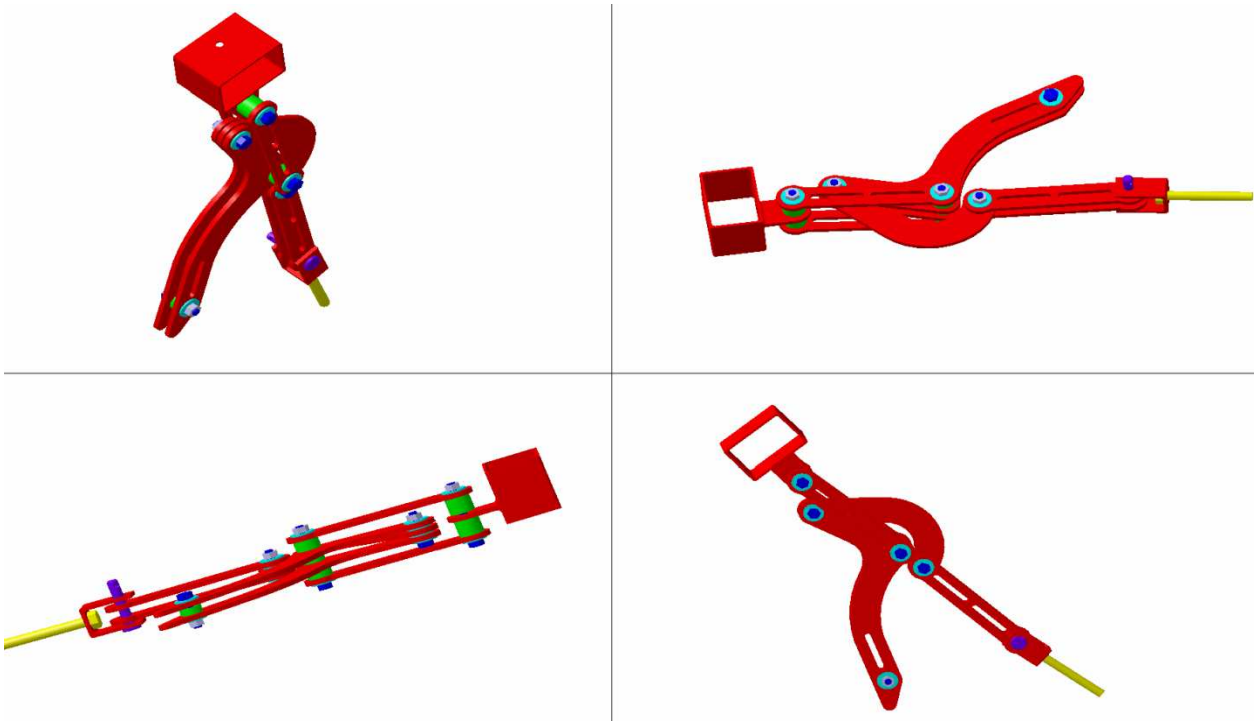

Fig. 2. The view on different planes [2]

A target group for using a new type of fastenings are Cross/Enduro motorcycles and their derivatives. They are characterized by high ground clearance and long suspension stroke. These characteristics were taken into account while designing the fastening. Suspension elements of these motorcycles, although they work in extreme conditions (rapid and strong deformations), they require care during transport. Long term, deep suspension travel, caused for example by fastening a motorcycle using a transport strap may lead to the damage of internal components. The new fastening minimises this risk because it does not cause such high suspension loads. It uses the resilience of these systems, but to a much lesser extent.

Based on the developed CAD model of the fastening, its detailed strength calculations were performed, empirically assuming the forces exerted on a motorbike during transport as well as ultimate strength calculations in extreme situations, e.g. in the case of a traffic collision. Fig. 3. shows example analysed dangerous sections. The study [2] shows that all strength assumptions in dangerous sections were met.

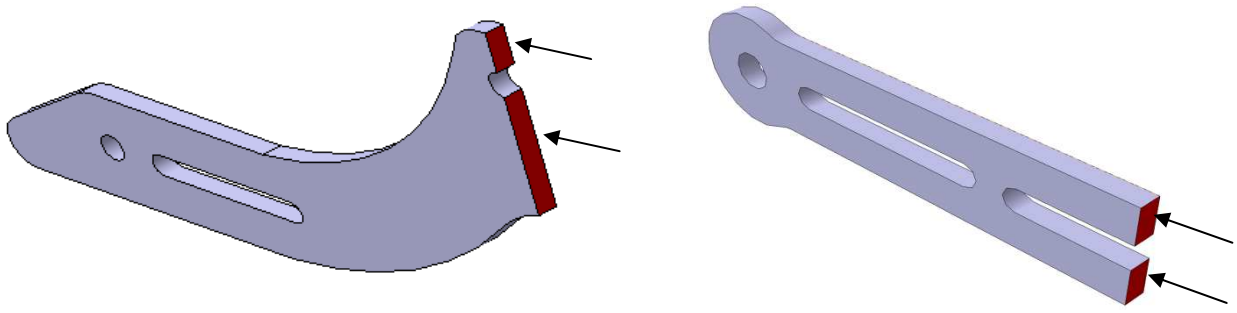

Fig. 3. Example dangerous sections [2]

Fastening presented in the study were implemented into production. Trade name of the ready-made fastening is BikePort.

Focusing on manufacturing technology, all the custom elements were designed using CAD software group. Thus prepared digital models were used in the treatment of metal and plastic.

Manufacturing technology provides powder coating of all components, allowing for a durable, coating resistant to scratches and cracking.

Fig. 4. shows ready-made solution for fastening a motorcycle.

a)

b)

Fig. 4. Ready-made system for fastening a motorcycle BikePort

3. Conclusions

Ensuring safety during transport and the possibility of quick fastening of sports motorcycles on trailers play a significant role during their transport. The motorcycle fastening system developed under the discussed project meets both these requirements and the additional requirement of fastening the motorcycle by one person only. The design and calculation works, as well as the functionality and strength tests performed on a real fastening system for sports motorcycles allow drawing positive conclusions as to high usefulness of the developed solution.

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NEW TRENDS IN THE DEVELOPMENT OF SERVICES PROVIDED BY POSTAL SERVICES OPERATORS ON THE EXAMPLE OF POCZTA POLSKA S.A.

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Abstract. The postal services market operates under a strong legislative, competitive and social pressure. This situation results from the liberalization of the postal services market within the European Union, communication revolution, e-commerce market development and gradual change in perceiving traditional postal services by the society due to the e-services which enter as a substitution within that scope. The new situation causes that the postal operators diversify their services portfolio with particular attention paid to the segments of fast-growing markets: new technologies, KEP, TSL. Origin and directions of such changes are the subject of this article.

Keywords: post, postal services, e-service, KEP, TSL.

1. Introduction

A decrease of revenues from traditional postal and financial services has been noticed on the postal services market in the countries, in which technology and economy are at a high level and dynamically develop [see 5, page 35-44]. It is caused due to optimization of costs by institutional clients (B2B, B2C[1]) and individual clients (C2C, C2B[2]) by provision of alternative and cheaper substituting services provided by electronic communication and so-called e-substitution of postal and financial services. In case of public postal operators, it is caused also by the policy implemented in terms of liberalization of the postal sector within the European Union in the public postal services segment.[3]. In case of traditional financial services (e.g. money orders, payments to bank accounts, cash payments for services at cash counters, etc.) it is due to popularization of non-cash payments, payment cards, credit cards, Internet banking and mobile payments.

The result of the presented situation is that the postal operators adapt to the changes, taking into account in their strategies [see 15] entering into the fast-growing market of KEP consignments, carriage of goods and provision of additional services on TSL market [7, p. 418] and they develop new services for the needs of recipients of banking and insurance postal e-services (e.g. the Internet Platform - Envelo Poczta Polska - http://www.envelo.pl/przewodnik.html [24] [see 14].

[1] both in the business-business relation (B2B) and business-client relation (B2C).
[2] both in the client-client relation (C2C) and client-business relation (C2B).
[3] The subject changes constitute a purposeful stimulated evolution which mainly results from the EU legal regulations, i.e. I, II and III Postal Directive and their implementation in the legal system of Member States. The third of the abovementioned directives specified the procedures for the complete liberalization of the postal market and determined the deadline for the complete opening of the common market on December 31, 2010 with a possibility to postpone the date by Member States to the end of 2012 [1,2,3].

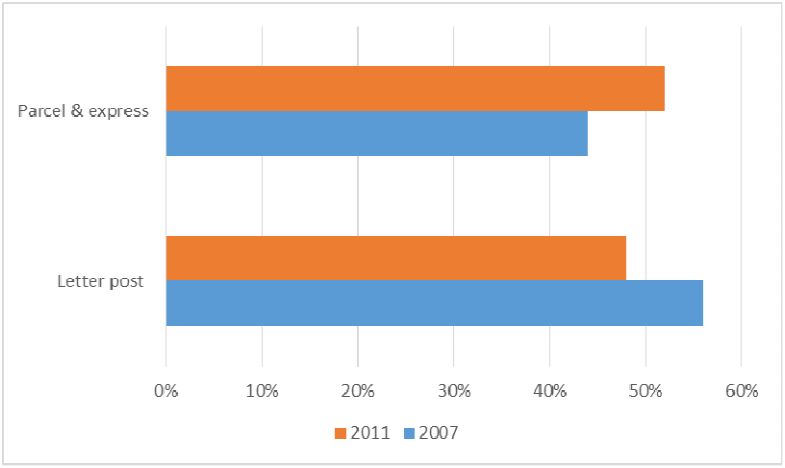
2. Analysis of the situation on the postal market - selected issues

The current situation on the global market of postal services, including the European Union and Poland entails the necessity to re-define the role and place of designated state postal operators. The changing operating conditions make it necessary to carry out a thorough restructuring not only in terms of the role of the national postal operators but in the entire postal sector. This process is at various advancement stages, depending on the degree of the postal market liberalization[4] and access to new technologies for the society. The advancement level within these fields determines the intensity of adaptation actions which condition a long-term "survival" and give a possibility of further development. Changes and their dynamics are extensive and multifaceted, and their strong influence is visible and affects the functioning of public postal operators.

An analysis of relevant literature, reports and reviews proves that in recent years, the postal services market is under strong pressure and dynamic changes can be noticed. The available information shows that various countries have different approach to the functioning of the postal services market and national operators. A gradual opening of the postal market started in 1989 in developed states of EU, first for parcels and then letters, and the process completed within the EU states at the end of 2012. An example may constitute the full liberalization of the postal services market in 1993 of *Sweden Post* and privatization of posts in the 20th century of, among others: Germany - *Deutsche Post*, the Netherlands - *PostNL* and Austria - *Osterreichische Post*. Some countries considered as liberal followed a different path: the United States and Canada, e.g. state post - *United States Postal Services - USPS*, operates up to the present day as a government agency, it has still ensured a partial monopoly for transferring letters [12], the post in Canada operates under similar conditions up to the present day - *Canada Post.*

In Poland, the liberalization process was implemented in several stages [16] according to the legislation applicable in EU, the 3-year transition period ends in 2015[5] and the Office of Electronic Communications (OEC)[6] according to the competences, has announced a tender on realization of public services by the operator designated for the period of 10 years [see 33].

In order to specify data which are relevant from the perspective of analyses of changes in the postal services market, a declining number of traditional letter mail and growing number of parcel and express mail should be taken into consideration. Fig. 1 shows the changes in the structure of performed postal services.



[4] The establishment of the internal postal services market within the EU Member States has been completed from a legal point of view in 2008. At the same time, the recommended legal structures were implemented in the Member States as well as a gradual liberalization of postal services, a complete report within that scope available [[35].

[5] The European Parliament established the date of the complete opening of the postal market and accordingly, it implemented transitional regulations which were available upon submitting relevant applications to the European Commission with justification, which was mostly used to adjust the national legal order and to complete the restructuring process of state-owned operators.

[6] OEC - the Office of Electronic Communication, the President of the Office of Electronic Communication is a regulatory authority in Poland in telecommunication and postal activity, more [34].

Fig. 1 European sector of postal services comparison of 2007-2011
Source: *Main Developments in the Postal Sector (2010-2013). Study for the European*, Directorate General for Internal Market and Services Commission WIK-Consult Bad Honnef, August 2013., p. 163.

Comparing to 2007, the value of the postal services market declined in 2011 from 94 to 91 billion Euro [8, p.163]. During this period, an increase could be noticed in the area of parcel and express mail services and decrease can be noticed in case of letter mail, however it is uneven across EU (Fig. 2).

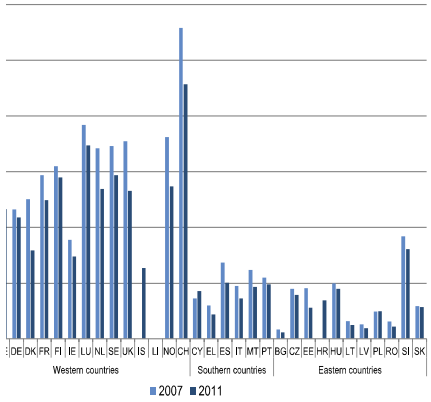


Fig. 2 Domestic letter mail per capita in 2007 and 2011
Source: *Main Developments in the Postal Sector (2010-2013). Study for the European*, Directorate General for Internal Market and Services Commission WIK-Consult Bad Honnef, August 2013., p. 167.

It results from the detailed data specified in Figure 2 that the most letter mail per capita fails in the countries of the Western Europe and in 2011 the largest decrease in demand for this type of services was noticed in comparison to 2007. A similar tendency, however with a lower intensity occurs in the Southern (Central) Europe and Eastern Europe. The exception is Poland, a detailed analysis has been presented in the report about the postal market condition available on OEC website [13]. On the basis of data concerning the volume of postal matter presented on Table 1, it can be concluded that the letter mail market is still growing and the data presented in the report shows a gradual decrease in the share of Poczta Polska S.A. in this sector of services in favour of private operators [36].

Postal matter	Volume (millions of items)							
	2006	2007	2008	2009	2010	2011	2012	2013
with unaddressed ad mail	5 090.5	5 193.3	5 410.7	5 5360	5 597.4	5 749.8	5 150.9	4 876.9
without unaddressed ad mail	1 802.1	1 994.3	2 002.5	2 011.3	2 018.8	2 018.7	2 001.8	2 085.7

Table 1 Number of postal matter in domestic and international trade in Poland between 2006-2013
Source: *Raport o stanie rynku pocztowego za rok 2013 [Report on the state of the postal market for the year 2013]*. Office of Electronic Communications, Warsaw, 2014, p. 36

The available data concerning the development and dynamic growth of the global market of e-commerce B2C sale is presented on Figure 3. The analyses presented in the available reports [23] show that the growth of the market in particular countries depends on the level of economic development.

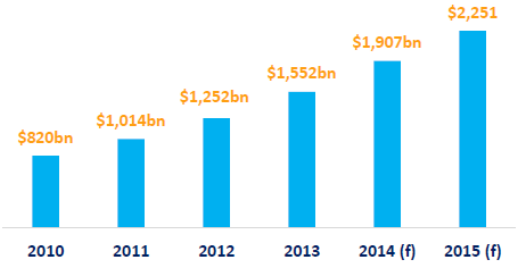


Figure 3 Global data concerning sales of goods and services on the e-commerce B2C market and the expected forecast for 2014/2015.
Source: http://www.ecommerce-europe.eu/facts-figures, (available on March 24, 2015);

The presented analysis of data related to the volume of letter mail with a simultaneous reverse tendency on the e-commerce market proves that the conditions on the postal services market are changing dynamically. It has been proved based on the analysis of the postal services market that the reason for such changes is liberalization of the market within the EU by purposeful changes in legal conditions causing an increase of competition, decrease of the volume of letters, noticeable particularly in the highly developed countries in connection with the e-substitution in the sector of traditional letter mail. An important parameter and prerequisite of e-substitution of postal services and e-commerce market development is an access to digital infrastructure which closely correlates in terms of a decrease on the market of traditional postal services and e-substitution in the form of an increase in the sales of products and services on the e-commerce market. The presented tendencies and the connection of the availability of digital infrastructure with the postal market and development of online sales explains also the increase in demand on the parcel and express mail market presented in Figure 1 due to the need to provide the customer with goods bought on the e-commerce market. The described dependencies have been presented in Figure 4.

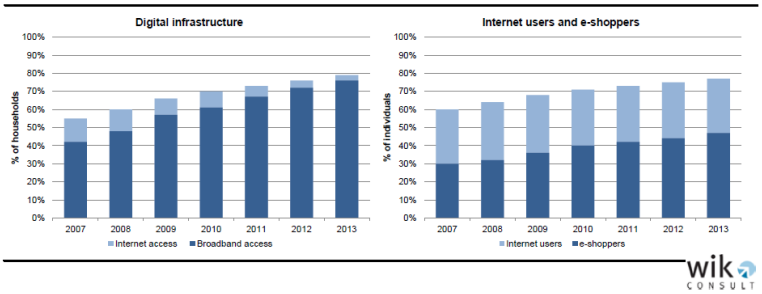


Figure 4 Digital infrastructure and the use of the Internet for purchases in the EU-28 between 2004-2013
Source: Main Developments in the Postal Sector (2010-2013). Study for the European, Directorate General for Internal Market and Services Commission WIK-Consult Bad Honnef, August 2013., p. 167.

To sum up, the competition in the field of e-substitution of postal services, liberalization of postal services within the EU and dynamic development of the e-commerce market have a direct influence on the behaviour of customers and it constitutes the major determinant of changes.

3. Adapting the new portfolio to the services of Poczta Polska S.A. to the changing environment

Each environmental factor, reducing the company's capability to obtain necessary resources or produce and implement its services on the market, becomes a hindering factor and also a force which triggers a certain change affecting the way of doing business and managing the company. The changes can be implemented by the company slowly or quickly. Slow changes of the company are easier to be controlled and implemented, and they also allow a better use of resources and costs over time. However, their effects may be negligible and slow, and their implementation may cause that the supply of the company becomes outdated. On the other hand, the fast changes disturb the balance, create new quality of labour conditions and relations, require high mobility of forces and resources, hinder their acceptance and enhance reluctance to implement them. Nevertheless, they allow for a rapid improvement of the condition of the company and strengthening of its competitiveness [10, p. 95].

Fast changes shall be significantly important in the activities of public postal operators in terms of transformations within the European sector of postal services. The rate of reaction and performance of necessary activities should be a factor of the highest importance for the companies which have to adapt to the changing environment, implement innovations and compete in these areas of a business activity which bring the most benefits. The ability to quickly and simultaneously implement numerous and various changes is crucial for the maintenance of a significant position of a public postal operator on the market.

However, the implemented changes should be planned, subject to public acceptance and dimensioned in terms of obtained benefits over a certain time and what is the most important is that they should be innovative. A lot of authors consider innovations as an introduction of any new idea and new technical inventions or improvements which allow for an increase of the quantity and quality of the implemented serviced, increase of labour productivity and investment level [11, p. 9].

The response of the Management Board of Poczta Polska S.A. to the changes observed on the postal services market was the development and implementation of the Strategy of Poczta Polska up to 2015 [15]. The presented solutions are continuously implemented and they have been included in the currently developed and presented strategy up to 2020 [19]. The strategy assumes a diversification of the ongoing postal services and a gradual replacement of declining services with the services tending to increase. This assumptions are illustrated in Figure 5 and they fit in with the tendencies presented in the part focused on the market analysis.

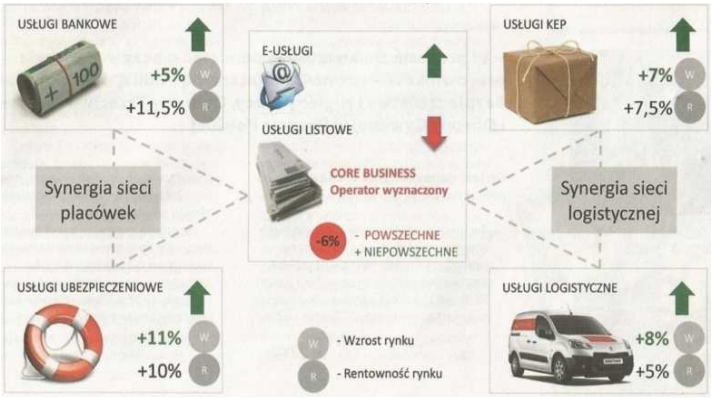


Fig. 5. Areas for development of Poczta Polska Group
Source: *S. Skarżyński, Nowa* ***Poczt@,*** *Magazyn Poczta Polska, No. 6(819)/ June 24, 2013;*

The main area of the company's growth in the strategy 2015-2020 will include parcels, courier mail and the entire value chain for e-commerce. Poczta Polska wants to achieve in this sector the revenue of 1,5 billion of Polish Zloty, that is 100% increase. The new strategy is to enable the company to effectively carry out the activity of an operator designated after a positive settlement of

the tender carried out by OEC and to increase the value of the Group before IPO in future [21]. The assumptions of the new strategy include the development directions which have already been performed in the previous strategy and which refer to the development of the services and new areas, the selected elements of such actions, concern in terms of this article:

- parcels and express courier mail for the companies operating within the e-commerce sector,
- services provided for TSL market in terms of transport and storage of pallets on the domestic and international market.
- postal as well as banking and insurance services in the digital sector.

The technological and organizational innovations have the most significant meaning for the development of mail in the current market conditions. Technological innovations include the changes related to the implementation of new services and process innovations. The first consist in the change of the performance of existing services or creation of completely new services [9 p. 59]. On the other hand, the process innovations are the new methods of implementation or distribution of services [10 p. 146]. Significant and strategic transformations should be made in the logistic system in order to carry out the process. Whereas, the organizational innovations relate only, among others, the structures in terms of the organization of the logistics chain and the ownership structure of the links of this chain, that is the involved entities. A proper development and innovations should provide an integration of its elements with the strategy and company's development directions.

The implemented and planned investments in the presented groups of services constitute an answer of the operator to the changes on the market of postal services and their advancement level is different in the European Union countries. The aim of the presented directions of changes in the services portfolio of postal operators is the answer to the changes and development of new needs of society and business. The type of actions taken in case of Poczta Polska S.A. results also from the conditions in the country, the nature of which may differ from the situation of other postal operators in the European Union [see 8].

From the group of development conditions of Poczta Polska S.A. strategy presented in the reports on the operation of the postal market in Poland and European Union results that the fastest growing is the e-commerce services market directly related with the services provided by the postal operators from KEP and TSL group [17 p. 418].

Diversification of the portfolio of Poczta Polska S.A. services is achieved by the introduction of the service including domestic road transport of pallet shipments in 2009 and also storage and warehouse services in subsequent years [26, 27]. It is important that the operations of the logistics process were and are the main business area of the postal operators which in case of Poczta Polska S.A, were developed and performed for the internal needs of the company in 2009 [6 p. 43-50]. Currently, the logistics postal chain and warehouse space have been made available for external shipments [18 p. 313]. The traditional postal services are directly connected with TSL market and from KEP group, they are provided for the needs of e-commerce market - the postal parcel and courier mail. It results from the analysis of KEP market in Poland [13] and in the world [20] that it is the fastest growing segment of the postal services market. Poczta Polska S.A. indicated in its offer the unlimited possibilities within this scope and develops individual offers for the needs of key customers of this industry [31].

Another group of services which are subject to the dynamic change are traditional postal services, where the changes result from their e-substitution and have also been used by Poczta Polska by creating an innovative platform for a free and safe communication directed to private persons, companies and public institutions. Envelo, a company of Poczta Polska S.A., uses the latest Internet communication channels and thus, it provides a convenient access to postal services by mobile and stationery devices [32]. An important element of digitization of postal services are applications supporting e-services: e-sender, e-monitoring, e-forms, e-info and mobile applications [28].

The nature of financial services provided by Poczta Polska is similar to other companies which offer banking and insurance services. These services include typical postal services, such as: postal

order and payment services [29] as well as specific services having complex cash logistics nature [25].

It can be concluded from the presented analysis of the selected portfolio of postal services that the offer is adjusted to the needs of customers and changes in the postal market. Traditional postal services have their counterparts in e-services and the post increases its presence in TSL market and also recovers the position in KEP market. Financial services constitute an important pillar of the development of the capital group7 operating under the brand of Poczta Polska S.A.

4. Conclusion

Based on the presented analysis of selected elements of the postal market, the potential, dynamic of the market especially in the context of the operation within the e-commerce market should be emphasized. The strategic element of the competitive advantage of public postal operators is their long-term presence and experience providing services to individual customers as well as the communication links network adjusted for this purpose and covering the whole country along with the connected logistics points infrastructure. The e-substitution of traditional postal services which is described in this article and especially the changes and technological innovations cause that the competitive advantage of state postal operators constitutes an important asset, however it is not sufficient for the operator to keep the position in the market. Maintaining the competitive advantage and position in the market will depend of the strategic decision, mainly in terms of e-substitution of traditional postal services and customer service in KEP and TSL market. The presented and implemented strategy concerning diversification of revenues of Poczta Polska S.A. by diversification and change of services portfolio in the context of keeping the market position depends mainly on the innovative technologies, digitization of the offer and they should be assessed from the perspective of the answer of the operator to its own and global situation in the postal market. Moreover, the analysis shows that they are a necessary condition to keep the position. Nowadays, the changes will help in the long-term perspective, the development of the target model as well as the social function which should be provided by the postal operators by reducing the distance between the quality standard of the provided traditional postal services and the size of digital communication.

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Computer-assisted Assessment of Energy Efficiency for Ship Power Systems on the Example of Fishing Cutters

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Abstract. The paper presents a proprietary software that enables the following energy efficiency indicators and indexes for ship power systems to be calculated: performance, Energy Efficiency Operational Index (EEOI), energy consumption per a tonne of transported freight, vessel operational costs. The calculation methods have been developed on the grounds of literature data, the requirements of classification societies and the International Maritime Organization (IMO).
Data necessary for the calculation and analysis is gathered in a database which is an integral part of the software. The required technical and operational data are: technical specification of a ship, machines and equipment of the power system, the results of power systems' operational tests, operational conditions in which the tests were carried out, the type and volume of transported freight, distance travelled and the ship's speed.
The calculation results regarding each energy efficiency indicator and index may be used for current assessment of the energy efficiency, operational costs and an impact of the operated ship on the environment, taking into consideration various ambient conditions and freight volume. The developed software may be also applied during modernization and design works.
The paper includes an example of the software application for the Polish fishing fleet.

Keywords: ship power systems, fishing cutters, energy efficiency.

1. Introduction

Previously, the term of energy performance has been commonly used to determine the energy efficiency of ship power systems as the measure of a conversion degree for the chemical energy of fuel used in a marine power plant. In order to mitigate environment pollution, especially by CO_2 emission, IMO entered into force, commencing on 1st January 2013, the requirement regarding the Energy Efficiency Design Index (EEDI), which is developed and mandatory for new ships, and the Energy Efficiency Operational Index (EEOI), obligatory for the ships in operation. The two indexes relate fuel consumption and CO_2 emission. EEOI is essential during drawing up Ship Energy Efficiency Managment Plan (SEEMP). All ships, both new-built and in operation, are subject to SEEMP, which provides optimal ship operation in terms of energy consumption and hazards to the environment [3,4,5,9].

The reduction of energy consumption by the energy system may be obtained due to a comprehensive approach to the problem, executing the following tasks: developing a concept and designing the system, selecting energy-saving and environment-friendly machines and equipment, drawing up and implementing procedures for energy management and calculating energy efficiency indicators and indexes for the design power systems.

The calculation results of the energy efficiency indicators and indexes for ship power systems, such as performance, Energy Efficiency Operational Index (EEOI), energy consumption per a tonne of transported freight, are needed to determine ship operational costs and the impact of the ship operation on the environment.

In order to make calculations it is required to develop calculation methods on the grounds of literature data, the provisions of classification societies and the International Maritime Organization (IMO), and to gather large amounts of data obtained during the operational tests on ships.

The paper refers to the calculation software developed for a specific type of ships such as fishing cutters. Giving the power systems' structure of fishing cutters and their intended operational tasks, the software includes the calculation methods for the following indicators and indexes: energy performance, EEOI, the indicator of energy consumption per a tonne of fish caught and the operational costs. An integral part of the software is a database allowing to collect technical data of fishing cutters and their power systems, operational conditions and the data obtained during operational tests used during the calculations.

2. Software specification

The developed software is for modeling logical relations between the real physical phenomena and mathematical relations dedicated for fishing vessels [1,2,6,7,10,11]. The calculations may be carried out using the data obtained during the operational tests on fishing cutters in order to obtain actual energy indicators and indexes for the vessel, as well as new power systems may be configured for fishing cutters and their energy indicators and indexes may be calculated.

The key tasks for the system a part of which is the software are as follows:

- providing the possibility of the acquisition of measurement and technical data on fishing vessels;
- providing the possibility to store data regarding fishing vessels on an independent server accessible from any PC connected to the Internet;
- performing calculations based on the technical and operational data of the analyzed vessels;
- developing new solutions for power systems and calculating their energy indicators and indexes;
- storing information concerning existing and modeled power systems, technical data of fishing cutters and calculation results;
- printing reports including the results of calculations and power systems' diagrams.

The database system has been developed in 2-tier architecture due to the expected limited a one-time number of users and the amount of data stored. Additionally, in that case, the two-tier architecture will be easier to restore the system, if a failure occurs.

The database for storing the calculation results, technical specifications and power systems' diagrams has been created on an external server. In order to manage the data on the server (a relational database server), the software of ***PostgreSQL GLOBAL DEVELOPMENT GROUP - PostgreSQL 9.3.1.*** has been applied.

The developed software enables to calculate the following energy efficiency indicators and indexes for fishing cutters: energy systems'performance, EEOI, the indicator of energy consumption per a tonne of fish caught and the operational costs.

The indicators and indexes have been selected considering the specificity of the fishing cutters' energy systems' structure, operational tasks and the requirements of fishing cutters' owners.

The paper presents two, the most important calculation modulars, incorporated in the developed software, enabling to determine the performance and EEOI for the power systems of fishing cutters.

3. Calculation of power system performance

A performance calculation modular allows to determine the performance for the existing power systems, the diagrams of which are in the database, simple power systems (with one main

internal-combustion engine) developed by a user and for complex power systems developed by a user (with more than one internal-combustion engine). A print-screen of a calculation of the power system performance is presented in Fig.1.

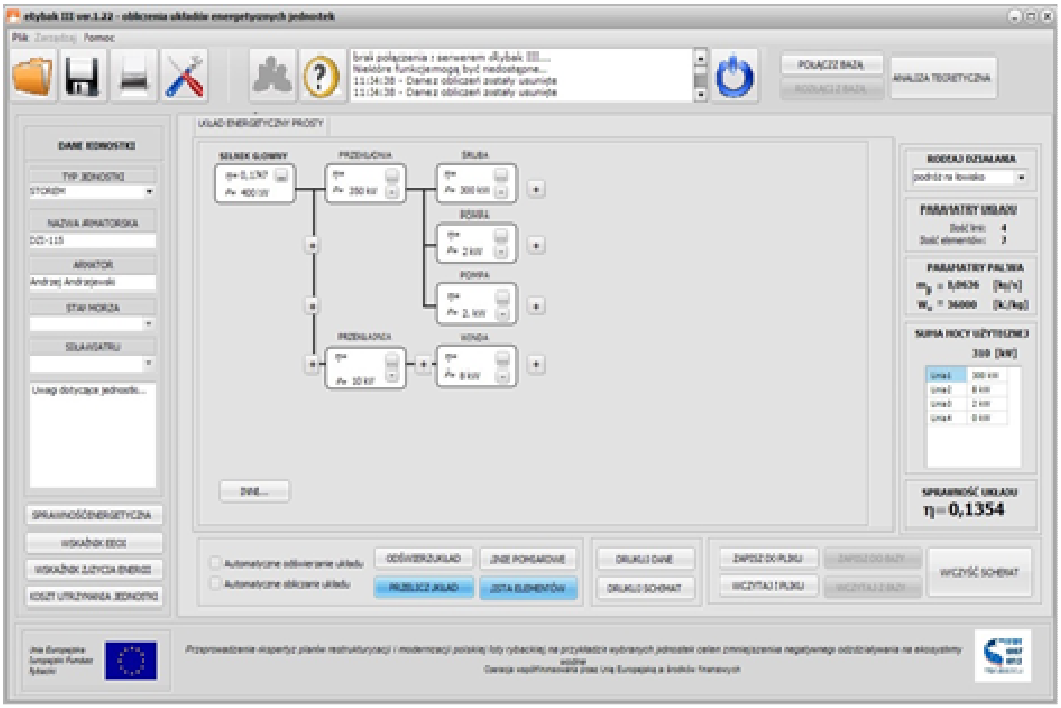

Fig. 1. Modular architecture to calculate power system performance.

Units presenting particular elements of a power system allow for the construction of a power systems in any configuration and upon entering the data obtained during the operational tests [8,12] or theoretical data, the performance values are computed.

4. EEOI calculation

The modular architecture to calculate EEOI is presented in Fig.2

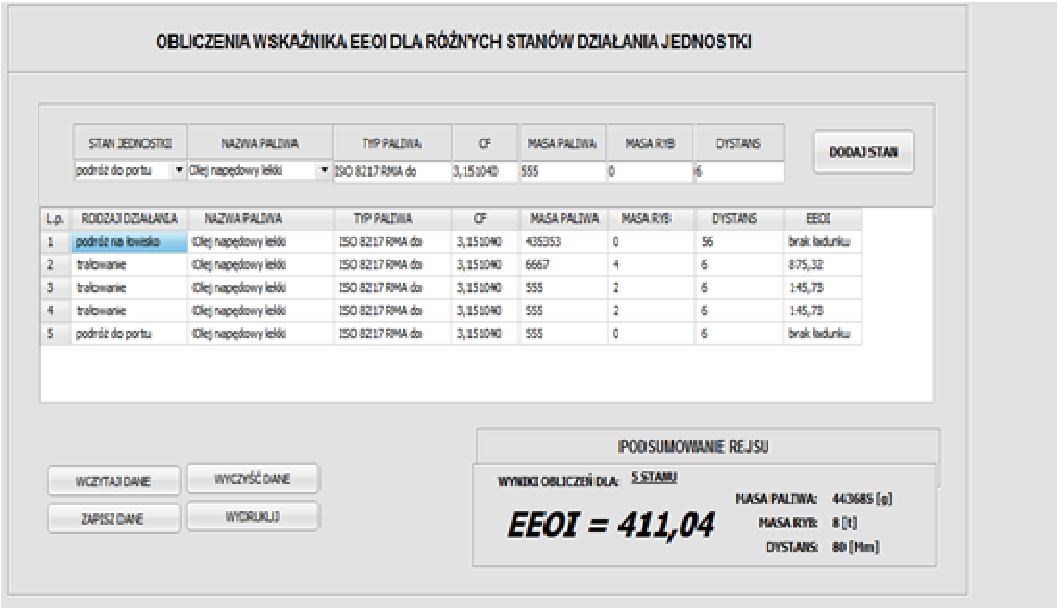

Fig. 2. Modular architecture to calculate EEOI for a fishing cutter .

The software allows to calculate EEOI for every operational tasks (free sailing and trawling), as well as for the entire travel. The calculated EEOI values allow to determine the CO_2 emission from internal-combustion engines and oil-fired boilers in the power system while the operational tasks are carried out.

5. Conclusion

The aim of the software is to facilitate and accelerate the calculation process in the scope of the energy efficiency indicators and indexes for the power systems of fishing cutters.

The software brought the complex and complicated calculation methods to one easy-to-use software, which is so accessible and simple that a person who does not work using a PC on daily basis would cope easily with an analysis of the energy efficiency of a vessel. Additionally, the calculation modules for power consumption per a tonne of fish caught or the maintenance costs will allow fishing cutters' owners to determine the costs and operating profitability.

Another advantage of the software is a possibility to analyze as well as to simulate the energy indicators and indexes and the costs per one trip, one operational task or a series of trips.

The possibility to construct new power systems in any configuration allows to perform a numerical simulation of energy effects and operational costs for fishing cutters. The results of the simulation allow a decision on power system modernisation to be made or to develop guidelines for a design of new fishing vessels' type.

The software is evolving and upon consultations and due to the suggestions from the users it will be modernised as well as new, useful function will be implemented.

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Energy Efficiency Operational Indicator – Assessment Tool of the Energy Efficiency for Fishing Cutters

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Abstract. The energy efficiency indicators, adopted by the International Maritime Organization (IMO), including the Energy Efficiency Operational Indicator (EEOI), apply to vessels operating in merchant fleets (containerships, bulk carriers, tankers) and refer to the cargo mass carried.
Giving the protected zones in which the Polish fishing fleet operates at the Baltic Sea, the adoption and implementation of more restrictive regulations on environment protection and taking into consideration the interest of shipowners in improving the operational efficiency of their cutters, it should be expected that the IMO regulations and provisions regarding fishing vessels will be adopted.
Taking into account the specificity of the operation of fishing vessels for which operational tasks are applicable (the most important are inter alia free-sailing and trawling) the possibility to adopt EEOI for this type of vessels should be analized and examined.
The paper presents the results of an analysis regarding the said possibilities based on the outcome of operational tests carried out on a selected fishing cutter and giving the IMO requirements in the scope of determining EEOI..

Keywords: fishing cutters, energy efficiency operational indicators.

1. Introduction

EEOI, developed by IMO and entered into force on 1st January 2013, allowing for the assessment of the vessel energy efficiency on current basis, may be calculated as follows [3,4,5,8]:

$$EEOI = \frac{\sum_j FC_j C_{Fj}}{m_{cargo} D} \qquad [gCO_2/t\ nm] \qquad (1)$$

where:
FC_j – all fuel consumed by main and auxiliary engines including boilers for work done
J – fuel type,
C_{Fj} – the fuel mass to CO_2 mass conversion factor for fuel j
m_{cargo} – is cargo carried (tonnes) or work done (number of TEU or passengers) or gross tonnes for passenger ships;
D – the distance in nautical miles corresponding to the cargo carried or work done

The application of the formula 1 requires to know C_F conversion factor the values of which for various fuel types used in shipbuilding is presented in Table 1.

During an analysis of the formula 1 components it may be stated that the aim of the formula was to determine the impact of the volume of the fuels (various types) combusted on ships on the environment pollution through the CO_2 emission

In order to calculate EEOI it is required to provide cargo mass or the number of passengers on a ship depending on the transport work. In the case of fishing vessels, during a certain operational task (work done) e.g. during a voyage to a fishery when no catching has been performed or during

changing a fishery following unsuccessful fishing, it is not possible to determine EEOI using formula 1.

Type of fuel	Reference	Carbon content	CF (t-CO2/t-Fuel)
Diesel/Gas Oil	ISO 8217 DMX do DMC	0,875	3,206000
Light Fuel Oil (LFO)	ISO 8217 RMA do RMD	0,86	3,151040
LPG	Propane Butane	0,819 0,827	3,000000 3,030000
LNG		0,75	2,750000

Tab. 1. C_F conversion factor values for fuels [8].

The solution of the issue regarding EEOI calculation for fishing cutters requires an analysis of indicator values for particular operational tasks (works done). Therefore, it is required to carry out operational tests on a cutter.

2. Operational tests performed on a selected fishing cutter

The operational tests have been carried out on a fishing cutter with the following technical parameters [1,2,12] :

- total length - L_C=17,6 m;
- total deadweight - B_T=42 BRT;
- operational speed - V_H=8,5 kn;
- engine type – PUCK SW 680;
- engine nominal power – N_n =167 kW;
- nominal rotational speed – n_n= 2000 RPM;
- fuel conversion factor – C_F= 3,20600.

The vessel executed five operational tasks (works). The tests showed that the cutter sailed the distance of 198 nm within 31h, consuming 0,867 tonne of fuel and catching 7 tonnes of fish [1,2,6].

The detailed measurement data obtained during certain operational tasks (works done) and calculated EEOI are presented in Fig.1.

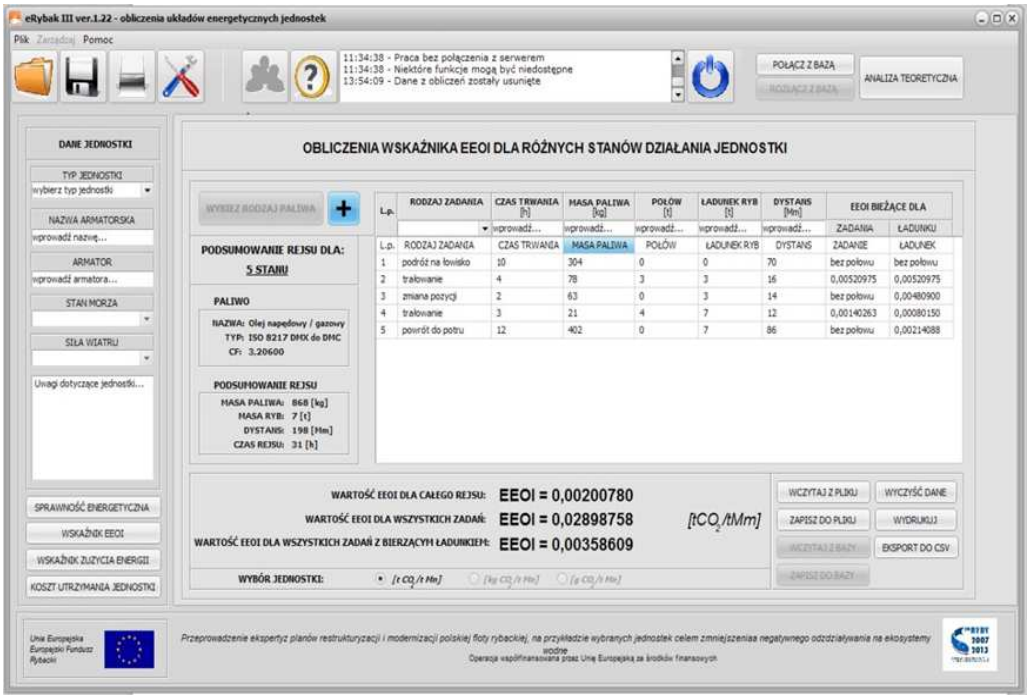

Fig. 1. Print-screen of EEOI calculation for fishing vessels.

Taking into consideration the differences of calculated EEOI values, more detailed analysis is required in order to apply the indicator for fishing vessels.

For the purpose of the EEOI calculation a proprietary software was applied. It allows to calculate EEOI for every operational task (work done) and in relation to the weight of fish caught. During the tests, the vessel performed 5 operational tasks (Fig.1, Tab.2): voyage to a fishery, trawling 1, change of fishery, trawling 2, return voyage to the port. While 3 tasks were carried out, the fishing cutter did not perform any fishing activities. Hence, there is no possibility to determine EEOI.

However, giving that there were fish onboard which were caught during the performance of the previous tasks (works), EEOI was calculated in relation to the transported cargo.

3. EEOI calculation method - proposition

In order to analyze in detailed the issue regarding EEOI calculation for fishing vessels, the data from Fig. 1 was used. The data is included in Table 2

Task (work done)	Time	Fuel consumption	No. of catch	Fish mass	Distance	EEOI for the task (work done)	EEOI for cargo
	[h]	[kg]	[t]	[t]	[nm]	[$tCO_2/t_{cargo}nm$]	[$tCO_2/t_{cargo}nm$]
Voyage to fishery	10	304	0	0	70	No fishing	No fishing
Trawling 1	4	78	3	3	16	0,00520975	0,00520975
Change of fishery	2	63	0	3	14	No fishing	0,004809
Trawling 2	3	21	4	7	12	0,00140263	0,0008015
Return voyage to port	12	402	0	7	86	No fishing	0,00214088
Total	31	868	7	7	198		

Tab. 2. Measurement data and EEOI calculation for examined cutter

The data provided in Table 1 present EEOI values calculated for the particular operational tasks (works done) performed by the vessel. It should be underlined that EEOI value for the particular operational tasks (works done) is not determined for the following operational tasks: voyage to a fishery, change of fishery, return voyage to the port, since the cutter did not catch fish at that time.

In the case of determining EEOI in relation to the fish caught and kept onboard, only in the case of one operational task (voyage to a fishery), it was impossible to calculate the indicator.

The following EEOI that was calculated is an indicator referring to the entire voyage. During the calculation the following numbers were taken into consideration: the mass of the fish brought to a port, the mass of fuel consumed during the voyage and the entire distance sailed during one voyage. The value of the indicator equaled to 0,00200780 [$tCO_2/t_{cargo}nm$] (see Fig.1).

The EEOI values, determined for the examined cutter and for all operational tasks (works done) during one voyage are presented in Fig.2.

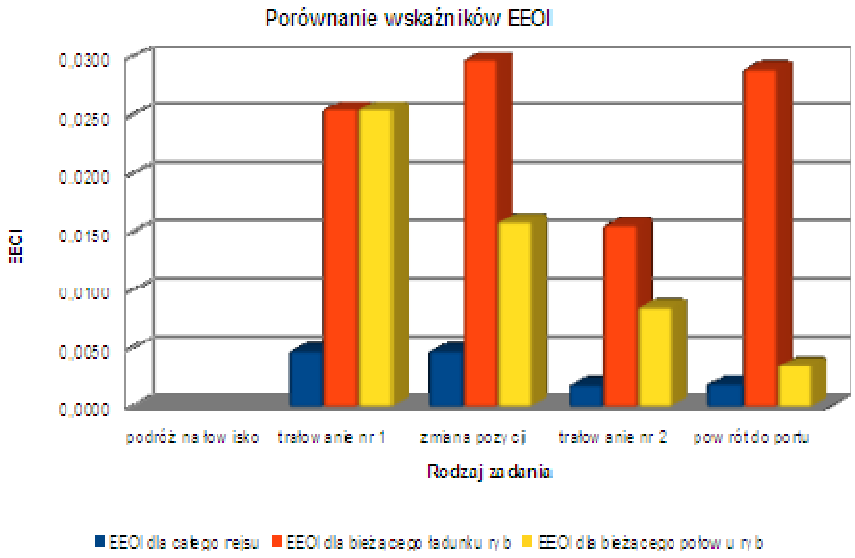

Fig. 2. EEOI for the examined cutter.

Regardless to the operational task (work done), EEOI reaches the highest values in relation to the mass of fish caught. Whereas the lowest value is related to the entire voyage.

4. Conclusion

The presented method for calculation and interpretation of EEOI allows for better assessment of the energy efficiency for fishing cutters during particular operational tasks (work done).

It has been proven that the EEOI values differ for particular operational tasks (works done). The indicators calculated for the task such as free-sailing (voyage to a fishery, position change, return voyage to the port) are of the highest value. It means that there is the greatest risk for the environment due to the CO_2 emission.

The calculated indicators, referred to one tonne of fish caught, make their value conditional only on the volume of the consumed fuel and distance traveled. The desire to improve the energy efficiency of fishing cutters means the EEOI values have to be minimized. It may be obtained by installing internal-combustion engines on fishing cutters, the performance of which is high, and by changing and improving hull shape in order to reduce hydrodynamic resistance values, and by voyage planning [5,6,7,9,10,11].

EEOIs determined for a number of subsequent voyages in various weather conditions allow to assess how operational conditions affect the EEOI values.

Using the developed software a numerical experiment may be carried out. The aim of it is to optimize the EOI value depending on installed internal-combustion engines of various volumes of consumed fuel as well as the power of the engine having an impact on cutter speed.

In relation to fishing cutters it is advisable to implement to determine EEIO for operational tasks performed by a cutter and for the entire voyage.

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Effects of Autonomous Vehicles on Road Safety

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Abstract. This paper deals with the effects of autonomous vehicles on the safety of all road users. They offer many noticeable benefits such as fewer traffic collisions and congestions. First part provides an overview of the situation on the roads in the recent years. Number of accidents, especially fatal ones, is a good safety indicator. Next chapter consists of a brief characteristic of autonomous vehicle technology. Few of the main hardware and software components are also presented. Main implementation issues that need to be solved before these vehicles can become a part of everyday life are introduced in the last chapter.
Keywords: autonomous vehicle, road safety, fatal accidents, implementation issues.

1. Introduction

A driverless car is an automobile that has an autopilot system allowing it to safely move from one place to another without help from a human driver. Ideally, the only role of a human in such a vehicle would be indicating the destination. The implementation of driverless cars could theoretically lead to many improvements in transportation, including a reduction in car accidents, more efficient transportation, and an increase in road capacity. There are, however, many obstacles to successfully implementing the driverless car as a common and effective method of transportation. This is especially true in situations in which a driverless car would need to safely navigate alongside normal cars directed by human drivers. To be useful, a driverless car must be able to navigate to a given destination based on passenger-provided instructions, avoid environmental obstacles, and safely avoid other vehicles [1].

Over 95% of road accidents involve some degree of driver behavior combined with some other factors. Usually the primary cause of an accident is the behavior of the driver. Most of the collisions are caused by excessive speed or aggressive driver behavior. Despite this fact, drivers always try to blame road conditions, equipment failure or other aspects [2].

2. Road accidents

Conventional driving imposes not only costs for the driver (e.g., fuel, depreciation, insurance), but also substantial negative externalities on other people. For example, every additional driver increases congestion for all other drivers and increases the chance that another driver will have an accident. While the frequency of crashes has been gradually declining, such incidents remain a major public health problem. AV technology can dramatically reduce the frequency of crashes. [3].

Road accidents are caused mainly by humans when they neglect or refuse to follow laid down rules, signs and regulations concerning the use of roads. Human factors in vehicle collisions include all factors related to drivers and other road users that may contribute to a collision. Examples of such factors include driver behavior, visual and auditory acuity, decision making ability and

reaction time. Driver impairment describes factors that prevent drivers from driving at their normal level of skill. Common impairments are for example alcohol, physical impairments such as poor eyesight, age, fatigue (sleep deprivation), drug use and distraction such as conversations and operating a mobile phone while driving.

As can be seen in Figure 1, the number of reported accidents in the USA has unstable characteristics. There is no trend, because the values vary in this period of four years from 2009 till 2012. On the other hand, there is a noticeable decline in number of accidents in EU and in Slovakia during the same years. Only around 1% of all the fatal accidents in EU take place in Slovakia. This type of accidents includes all the victims who die within 30 days of the accident as a result of injuries sustained.

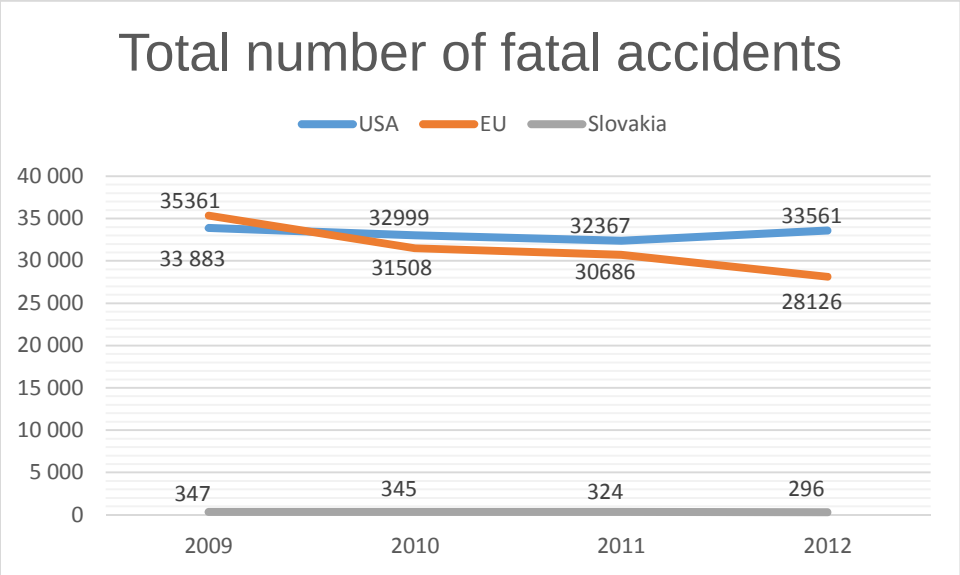

Fig. 1: Total number of fatal accidents
Source: processed by authors based on [7, 8, and 9]

The Insurance Institute for Highway Safety (IIHS) estimated that if all vehicles had forward collision and lane departure warning systems, sideview (blind spot) assist, and adaptive headlights, nearly a third of crashes and fatalities could be prevented. Automatic braking when the car detects an obstacle will also likely reduce a significant number of rear-end collisions. The overall social welfare benefits of vehicles that crash less frequently are globally significant and many of these benefits will go to the buyers of autonomous vehicles. [3].

3. Autonomous vehicles

Autonomous vehicle (AV) technology offers the possibility of fundamentally changing transportation. Equipping all of the vehicles with this technology will likely reduce number of crashes, energy consumption, pollution and reduce the costs of congestion. This technology is most easily conceptualized using a five-part continuum presented by the National Highway Traffic Safety Administration (NHTSA), with different benefits of the technology realized at different levels of automation:

• **Level 0 (no automation):** The driver is in complete control of the primary vehicle functions (brake, steering, throttle, and motive power) at all times, and is solely responsible for monitoring the roadway and for safe vehicle operation.

• **Level 1 (function-specific automation):** One function is automated. If multiple functions are automated, they operate independently of each other.

• **Level 2 (combined-function automation):** More than one function is automated at the same time (e.g., steering and acceleration). The driver is still responsible for monitoring the roadway and safe operation, and is expected to be available for control at all times and on short notice.

• **Level 3 (limited self-driving automation):** The driving functions are sufficiently automated that the driver can safely engage in other activities.

• **Level 4 (full self-driving automation):** The vehicle is designed to perform all driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. [3].

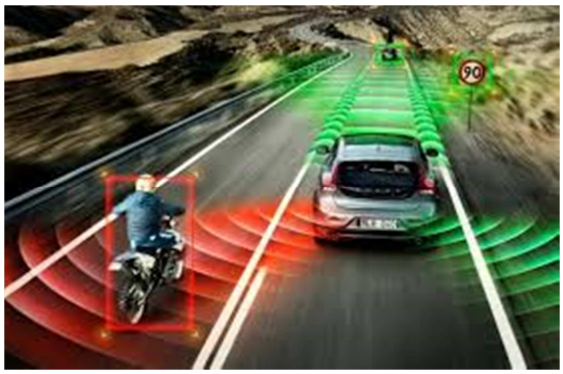

Fig. 2: Autonomous vehicle
Source: [10]

The hardware and software needed for autonomous driving is maturing and vehicle manufacturers and Tier 1 suppliers are edging closer to series production of their products. Some of the main components of autonomous vehicles are:

- **Sensor technologies** are developing a holistic solution that generates exact positioning and a complete 360° view of the car's surroundings. This is achieved by a combination of multiple radars, cameras and laser sensors. Precise positioning is based on this surround information together with GPS and a high definition 3D digital map that is continuously updated with real-time data. The system is reliable enough to work without requiring driver supervision.
- **Combined radar and camera** placed in the windscreen reads traffic signs and the road's curvature and can detect objects on the road such as other road users.
- **Surround radars** behind the front and rear bumpers (one on each corner of the car) are able to locate objects in all directions. By sweeping both left and right, transmitting waves that bounce off signs, poles, and tunnels, they monitor a full 360° around the car.
- **360° surround vision** cameras monitor objects in close proximity to the vehicle. Two are under the outer rear-view mirrors, one is in the rear bumper and one is in the grille. Besides detecting objects at close range, these cameras monitor lane markings. The cameras have a high dynamic range and can handle very quick changes in lightning conditions, e.g. when entering a tunnel.
- **Multiple beam laser scanner** is placed in the front of the vehicle, below the air intake. The scanner can identify objects in front of the car and ensures very high angle resolution. It can also distinguish between objects. The unique laser sensor has a range of 150 metres for vehicles and covers a 140° field of view. On the other hand, the trifocal camera can spot suddenly appearing pedestrians and other unexpected road hazards.
- **Ultrasonic sensors** around the car are used to identify objects close to the vehicle and support autonomous drive at low speeds.The sensors are based on the technology used for current park assist functions enhanced with advanced signal processing. A typical example of when this

technology is useful is for detecting unexpected situations, such as pedestrians or hazards on the road close to the car.

- **High performance positioning** is one part of the positioning control that is enhanced by a combination of an advanced GPS, a 3-degrees of freedom accelerometer and a 3-degrees of freedom gyro. By matching the 360° image created by the multitude of sensors with the map image, the car will get the information about its position in relation to the surroundings. [5].

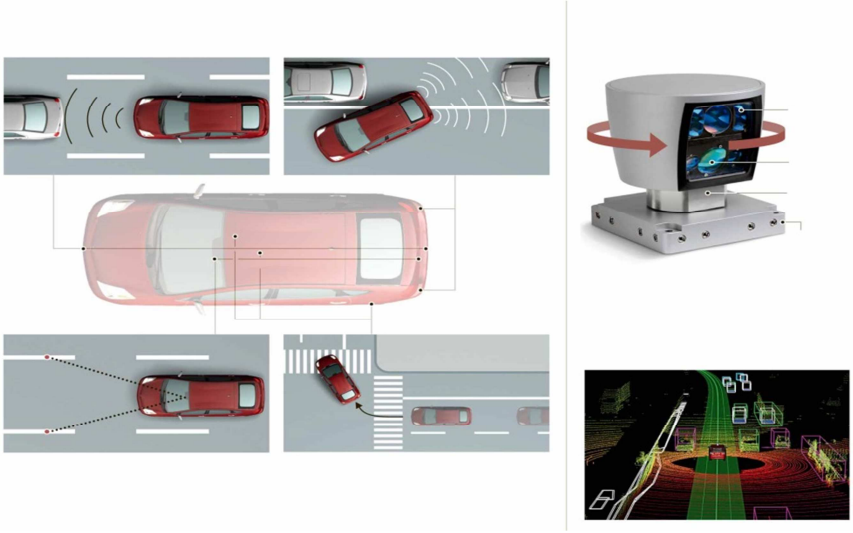

Fig. 3: Working principle of autonomous vehicle components
Source: [11]

4. Implementation issues

It seems that all the ingredients are available: ample computing power, state-of-the-art sensors and widespread digitization. The simple premise is that a processor can act in milliseconds to provide inputs to the vehicle systems, whereas a human, even if paying full attention is not capable of acting in such a short time. Experts offer a word of warning for the automotive industry regarding a reliance on autonomous vehicles. Automating the wrong way can increase system complexity what means a higher risk of unexpected issues. What will happen when the driver is taken further out of the loop, and how to transfer control between driver and the vehicle still have to be considered. It is not that easy and a close look has to be taken at these issues.

The important parts of the Vienna Convention that need to be clarified or even altered are Article 8, Paragraph 5, which states that ‘Every driver shall at all times be able to control his vehicle’, and Article 13, Paragraph 1, which states, ‘Every driver of a vehicle shall in all circumstances have his vehicle under control so as to be able to exercise due and proper care and to be at all times in a position to perform all maneuvers required of him’. A driver of an autonomous vehicle would be in contravention of these statements. One of the hurdles to revising the convention is that member countries of the European Union have different ideas of the best way forward. Currently there is no firm agreement on the re-wording, and that doesn’t look likely to change in the short term. [4].

Volvo, one of the most active manufacturers of autonomous vehicles, will test 100 of its autonomous cars on public roads driven in normal traffic by members of the public by 2017. The car manufacturer announced a collaboration with Swedish legislators and transport authorities to test the cars on 30 miles of roads around Gothenburg by 2017. Participants in the trial will have to be sober and competent to take over controls at any time. The system should be capable of handling a range of driving conditions including smooth commuting to heavy traffic and emergency situations, although its test roads will be without pedestrians, cyclists or on-coming traffic. [6].

5. Conclusion

Careful policymaking will be necessary to maximize the social benefits that this technology will enable, while minimizing the disadvantages. Yet policymakers are only beginning to think about the challenges and opportunities this technology poses. There are ongoing discussions about insurance, injuries and fiscal damage of the car. Some of the manufacturers talk about taking responsibility if the system malfunctions, but others say that they are willing to do so only if there are some logging problems.

AV technology has the potential to substantially affect safety, congestion, energy use and, ultimately, land use. There are many potential advantages to using a driverless car instead of a traditional human-controlled vehicle. Achieving the plan of zero deaths on the roads is possible only through the integration of automated technology. Technologies that permit the car to be primarily responsible for driving (Level 4) will likely further reduce crash statistics because driver error makes up for a large proportion of crashes.

Some experts believe that autonomous vehicles will be a regular thing by 2025 and basically a monopoly by 2030. I do not think that there will be a time when 100 percent of all vehicles on the road will be driverless. Drivers will have to be always ready to take over the vehicle if and when the software crashes. The technology may be advanced, but there are still many hurdles to jump before autonomous vehicles become a common sight.

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Factors Affecting the Road Safety

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Abstract: This document deals with road safety issues and factors that influence the road safety. The first part elaborates the importance of road safety and development of accidents in selected countries. The second part of document describes various factors that influence the road safety. The factors are divided into three groups: the infrastructure, the vehicle and the driver. The document specifically dedicated to the driver group is deemed a significant factor that influences road safety. It offers another view of increases in road safety by promoting the public transport.

Keywords: safety, road traffic, accident, driver

1. Introduction

Road safety represents a society issue not only in the EU countries but also in the non-EU states [1]. The number of fatalities per 100.000 of population represents more than 2 persons annually depending on the member state [2]. Peden et al. analyse the statistics of road fatalities worldwide [3]. Subramanian emphasizes the severity of problem [4], as road accidents in the US play the main role in deaths of children, youth and adults below the age of 34. Many authors such as Koornstra et al. [5] Wegman and Oppe [6] confirm the sustainable improvement in road safety as the number of fatalities in road traffic has got a decreasing tendency. On the other hand though, the number of accidents and mainly the number of fatalities still reflect a significantly higher numbers than the EU strategic targets [7]. It is therefore necessary to seek another solution in order to increase the road safety. Due to the fact, the goal of this document is to analyse factors that influence the road safety and to identify another solutions that would lead to the increased road safety.

2. Accident Statistics in Selected EU Countries

According to the statistics from 1970 to 2012 [8] on the number of fatalities per 100.000 of population in road accidents we can state that during 40 years, there had been a significant decrease in road fatalities (see Table 1). For example, in the Czech Republic the rate of fatalities had decreased from 20.2 in 1970 to 7.1 persons in 2012. In the Great Britain the ratio had decreased to 2.8 killed persons per 100.000 of population annually. In the Slovak Republic the number of fatalities reach 5.5 persons per 100.000 of population in 2012. To understand the change in road safety it is necessary to identify factors that influence it.

Country / year	1970	1980	1990	2000	2010	2012
Czech Republic	20,2	12,2	12,5	14,5	7,6	7,1
Germany			14,2	9,1	4,5	4,4
France	32,5	25,4	19,8	13,7	6,4	5,8
Slovak Republic				11,7	6,4	5,5
United Kingdom	14	11	9,4	6,1	3,1	2,8
Norway	14,5	8,9	7,8	7,6	4,3	2,9

Tab. 1. Number of fatalities per 100.000 of population in road accidents between 1970 - 2012

3. Analysis of Factors Affecting Road Safety

According to Oster and Strong [9], factors that influence the road safety can be divided into three groups:

- road and traffic environment and engineering,
- vehicle characteristics and performance,
- driver's behaviour and performance.

Significant improvements contributing to the increased road safety would have been made mainly in the road network quality, especially through the construction of superior road networks known as motorways. In vehicles, innovative methods and tools have been deployed to prevent from accidents [10]. These changes have significantly contributed to the increased road safety. According to Evans [11], all three groups are deemed important even though he trusts the main factor influencing the accidents occurrence being the driver's behaviour and performance. According to Shinara (2007) [12] the driver's behaviour and performance are the core factors influencing the road safety. These statements can be demonstrated through statistics of road accidents in the below diagram 1. Based on the analysis of road accidents, over 63 % of all road accidents were caused by drivers' behaviours.

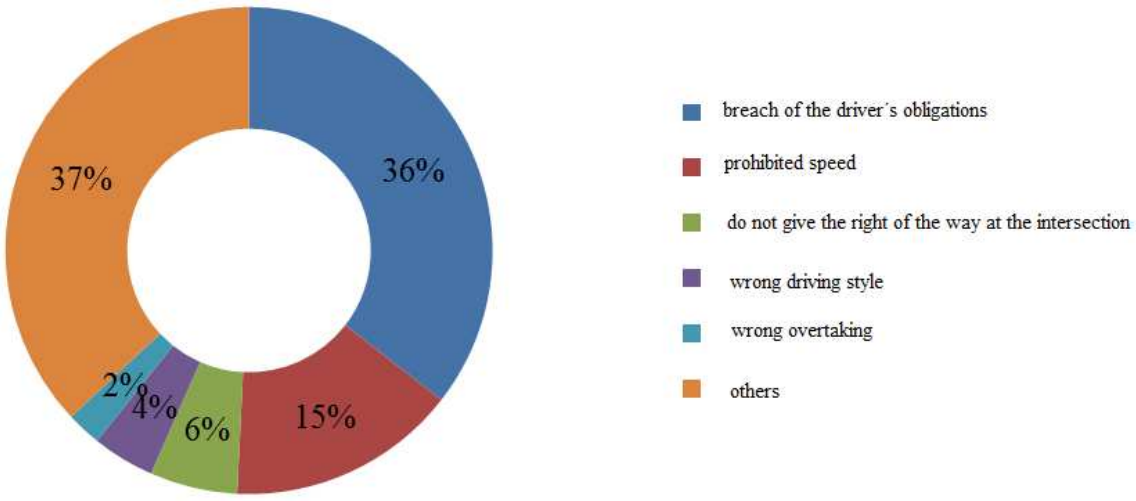

Fig. 1. Root causes of road accidents in the Slovak Republic in 2012

As per the above and i.e. by Elvik et al. [13] it is possible to proclaim the road safety to be influenced by:

- compliance with risk key factors,
- use of restrictive and protective devices,
- impaired driving skills and distractions of driver,
- speed,
- alcohol and drugs,
- use of mobile devices while driving and so on.

The driver's achieved education level has a small impact on road safety. The cases where safety classes have been taken by persons seem to have positively effected the road safety. According to Evans (2004) [14] passing the driver's test has reduced the risk of accidents among young drivers. According to a study processed in the US [15], the better understanding and increased legal enforcements for intoxicated drivers have increased the road safety, too.

If we assumed a lower probability of road accidents to be caused by professional drivers, we would indirectly increase the road safety through the support of public transport. The higher safety standards performed by professional drivers operating the buses have been confirmed in the surveys led by Chimba et al. or Blower et al.

4. New Suggestions to Improve Road Safety

Current practices on the road safety improvements are aimed at the quality upgrades of road infrastructure and the regulated road traffic in cities' residential areas. Improvements in the road infrastructure quality significantly contribute to the increased road safety. On the other hand, it increases the attractiveness of individual road transport [18]. The increasing number of vehicles and the traffic intensity increase the risk of accidents. A new view to improve the road safety being via the stabilized or increased number of passengers in public transport. The global problem, above all in the economically developed countries being the continuous decrease of passengers in public transport reflected in the number of carried passengers [19]. This is caused by the increase in individual automobile transport which both directly impacts the road traffic flows and increases the probability of road accidents. In the effort to improve the road safety and to persuade public to migrate to the public transport from their cars it is necessary to find feasible remedies. By supporting the use of public transport operated by experienced drivers which directly lowers the number of road accidents. Additionally, the road traffic intensity will reduce, leading to the higher road safety. It is obvious that the intense support of public transport use has a multiplied impact on the overall road safety.

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Use of progressive methods of public warehousing in Slovak Republic

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Abstract. Warehousing significantly contribute to creation of utility value of time and place. It enables the product to be produced and preserved for later consumption. It is fit to warehouse the product near the place of consequent consumption or near the place where the following transport will start. Activities connected to warehousing are related to designing, planning and layout of storehouses, decision-making about storehouse ownership, automation, staff training and other areas.
In this article, the warehousing in the Slovak Republic (SR) will be analysed on the basis of following criteria:

- division of warehouses in the SR according to autonomous regions,
- division of warehouses in the SR according to storage capacity,
- analysis of public warehouses from the using information technologies viewpoint (as for example RFID, WMS or bar codes are).

Keywords: Public warehouse, Self-governing region, analysis, map, information technologies, storage area.

1. Public warehouses in the Slovak Republic

In the market economy, in which liberalization is being enforced increasingly, a constant verification of transport options and new transport routes is taking place. It's not only caused by the impact of increasing competition in the global shipping market, but also by many other effects related to individual states which are under the pressure of internal, political or economic problems. With the development of new transportation systems, implementation of intermodal transport and the application of logistic principles, the role of transport is increasing not only in the transport process but in the world economy as well.

Along with the gradual increase of international trade, global revenue resulting from it and from activities associated with it are growing too. Individual countries are involved and they support international trade. They use instruments of national economic policy for an immediate exertion on international trade, which leads to strengthening of the competitiveness and productivity of the given country, which allows them to improve the living standards of the population and in some countries even public safety as a response to economic sanctions of political-economic groupings.

In case of goods, the export and import from and into a country is associated with its movement, i.e. with international transport. The method and quality of transport may have a significant overall affect on the effect of the foreign trade operation, not only by increasing the prices of goods depending on transport costs. [1-3]

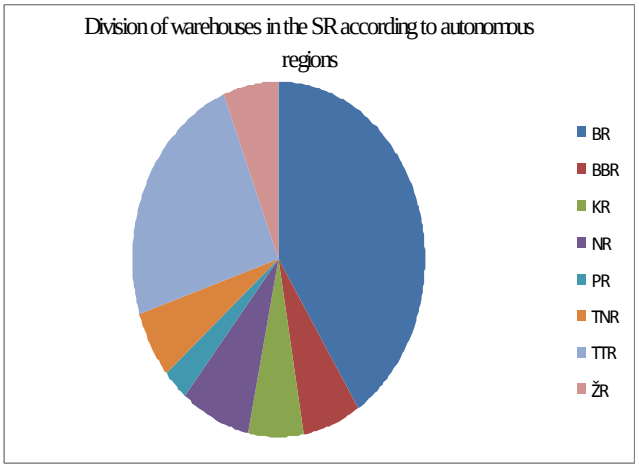
2. Analysis of the current state of EU economy

Public warehouse is operated as independent enterprise which supplies services for fix or variable charges. These services have usually standardized character. We distinguish five types of public warehouses, in concrete the commercial goods warehouse, the chilled or frozen goods warehouse, the special commodity warehouse, bonded warehouse and household equipment and furniture warehouse. These differ in the way of manipulation with material of goods and warehousing systems. [5]

The server www.skladuj.sk, which offer the overview in the area of warehousing, warehouse lease of warehouses and logistic centers equipment register 404 public warehousing premises in the Slovak Republic and in addition 37 warehouses designed by property developers. Spatial distribution of these warehouses according to autonomous regions you can see in the following table 1 and picture1. [4]

Table and Picture No. 1: Division of warehouses in the SR according to autonomous regions

Region	Number of warehouses	Percentage
BR (Bratislava)	165	40,64
BBR (Banská Bystrica)	26	6,9
KR (Košice)	25	6,16
NR (Nitra)	31	7,88
PR (Prešov)	11	2,71
TNR (Trenčín)	25	6,16
TTR (Trnava)	96	23,4
ŽSR (Žilina)	25	6,15
Altogether	404	100



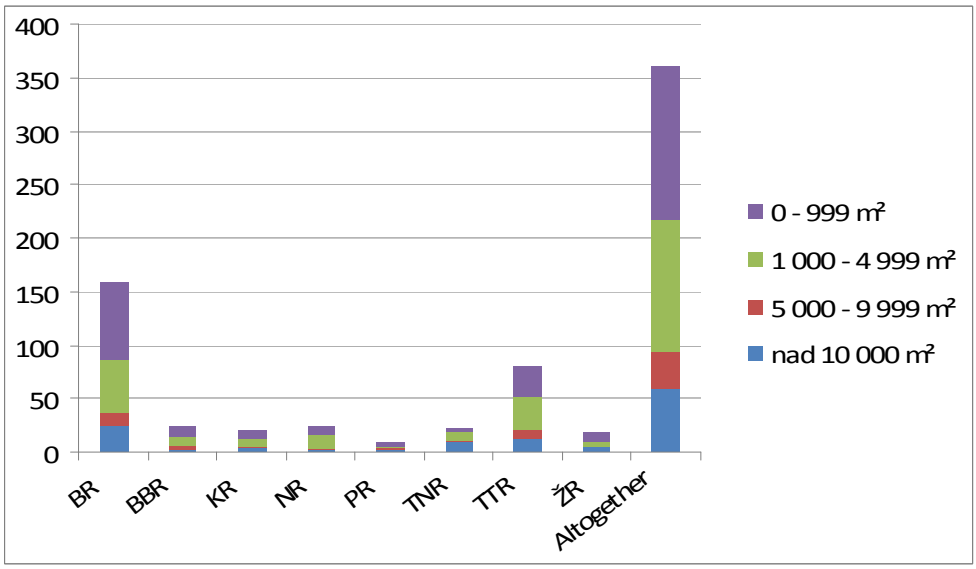
Source: www.skladuj.sk

It is clear from the table and Picture 1 that division of warehouses in the SR is uneven. Most of public warehouses (40,64 %) we can find in the Bratislava region. On the second place is Trnava region with 23,4 % share. Other regions have approximately the same percentage, in concrete it is 6-7 %. The Prešov region is on the last place with minimum warehouses which may be caused by low economic activity in this region.

Public warehouses were analysed also according to storage capacity. Outputs and results of this analysis you can find below in the table 2. [4]

Table and Picture No. 2: Division of warehouses in the SR according to storage capacity

Region	More than 10 000 m^2	5 000 – 9 999 m^2	1 000 - 4 999 m2	0 - 999 m^2	Without information about area	Altogether
BR	25	12	49	72	7	165
BBR	2	4	9	10	1	26
KR	3	3	7	8	4	25
NR	2	1	14	8	6	31
PR	1	3	2	3	2	11
TNR	9	2	7	4	3	25
TTR	13	8	31	29	15	96
ŽR	5	0	4	10	6	25
Altogether	**60**	**33**	**123**	**144**	**44**	**404**



Source: www.skladuj.sk

Surprising is the fact that capacity of most of the public warehouses is less than 999 m2, in concrete the deal of these warehouses is 35,6 % of all public warehouses in the Slovak Republic (this assertion is not valid in the independent region Nitra). Equipment of these warehouses is on the common level. It is adapted on common goods that do not require any special equipment of the public warehouse. [4]

3. Using of information technologies in public warehouses

The analysis showed that not one of 25 enterprises in the independent area Bratislava operating the warehouse with capacity over 10 000 m^2 use the RFID technology, only one warehouse in this area use the WMS system (Warehouse Management System) and only 4 enterprises use for warehousing the bar codes. Only one of all developer projects planned in the Bratislava region is going to use the RFID technology although using the RFID technology is in present the trendy and one of ways how to speed up warehousing operations (another trend is to use the WMS system). This information is really alarming. Warehousing companies using the bar codes technology are only in above mentioned Bratislava region, Trnava region (where it includes two existing

companies and two in the phase of developer project) and one company in Nitra region. We can state that it is only a tiny percentage of all warehousing companies with storage capacity over 10 000 m^2 **(0 % of companies use the RFID technology, 1,23 % use the WMS system and 1,17 % use the bar codes technology)**.

If we take into account all warehousing areas we can see the usage of above mentioned technologies in the table 3 below.

Table 3: Usage of information technologies in public warehouses in SR

Region	Number of warehouses using RFID according to storage capacity		Number of warehouses using bar codes according to storage capacity		Number of warehouses using the WMS system	
	0 - 999 m^2	1	0 - 999 m^2	3	0 - 999 m^2	0
	1 000 - 4 999 m^2	2	1 000 - 4 999 m^2	8	1 000 - 4 999 m^2	7
	5 000 - 9 999 m^2	1	5 000 - 9 999 m^2	4	5 000 - 9 999 m^2	3
BR	over 10 000 m^2	0	over 10 000 m^2	4	over 10 000 m^2	1
Altogether BR		**4**		**19**		**11**
	0 - 999 m^2	0	0 - 999 m^2	0	0 - 999 m^2	0
	1 000 - 4 999 m^2	0	1 000 - 4 999 m^2	0	1 000 - 4 999 m^2	0
	5 000 - 9 999 m^2	1	5 000 - 9 999 m^2	2	5 000 - 9 999 m^2	1
BBR	over 10 000 m^2	0	over 10 000 m^2	0	over 10 000 m^2	0
Altogether BBR		**1**		**2**		**1**
Altogether KR		**0**		**0**		**0**
	0 - 999 m^2	0	0 - 999 m^2	0	0 - 999 m^2	0
	1 000 - 4 999 m^2	0	1 000 - 4 999 m^2	3	1 000 - 4 999 m^2	1
	5 000 - 9 999 m^2	0	5 000 - 9 999 m^2	0	5 000 - 9 999 m^2	0
NR	over 10 000 m^2	0	over 10 000 m^2	1	over 10 000 m^2	1
Altogether NR		**0**		**4**		**2**
Altogether PR		**0**		**0**		**0**
Altogether TNR		**0**	1 000 - 4 999 m^2	**1**	0 - 999 m2	**1**
	0 - 999 m^2	0	0 - 999 m^2	0	0 - 999 m^2	0
	1 000 - 4 999 m^2	0	1 000 - 4 999 m^2	2	1 000 - 4 999 m^2	1
	5 000 - 9 999 m^2	0	5 000 - 9 999 m^2	1	5 000 - 9 999 m^2	1
TTR	over 10 000 m^2	0	over 10 000 m^2	2	over 10 000 m^2	3
Altogether TTR		**0**		**5**		**5**
Altogether ŽR		**0**		**0**		**0**
ALTOGETHER SR	**5**		**31**		**20**	

Source: www.skladuj.sk

Public warehousing companies in three regions - in Košice region, in Prešov region and in Žilina region are not equipped with any information technology designated for speed up identification of goods and for making the awareness about goods in warehouses clearer. It is necessary to point out that warehouses which use for the evidence about goods the WMS system

must be also equipped by the bar code technology and therefore these are duplicately included in both criteria of segmentation of warehouse companies. [4]

If we would focus in the analysis on warehousing areas over 10 000 m^2 the statistic of using information technologies would be following:

- The RFID technology use five warehousing companies which makes 1,24 % of all 404 warehouse companies,
- The bar codes technology use 31 public warehousing companies which makes 7,67 % of all 404 warehouse companies,
- The WMS system use 20 of 404 warehouse companies which makes 4,95 %,

From the warehousing area viewpoint we can state that the most use information technologies warehouse companies with total area between 1 000 and 4 999 m^2.

4. Conclusion

Trends in this area are mostly made by western states with strong economy and states as for example the Slovak Republic is can choose. These can either find their own way or join the other states. Change of present state in the Slovak Republic consists in focusing on fast modernization and completion of infrastructure. In European context the Slovak Republic has logistic potential what we can prove by the force of numerous researches and expert opinions. Arrival of investors and their subcontractors made a flying start of development of logistics in the Slovak Republic. It is necessary to search for opportunities for creation of competitive advantage in each region in order to help logistics to increase and not to stop on present quality level. The support of the government by developing the infrastructure, cultivating in the logistics area or motivating carriers to use multimodal resolution of their needs are only examples how can government and the state contribute to logistics.

In west Europe logistics hits capacity and space barriers in large industrial agglomerations and in addition environmental impacts of all activities becomes more and more important factor for supplying companies. Mentioned capacity barriers force this sector to geographic decentralization of all activities towards east and simultaneously concentration of all activities to reach the economies of scale. Impacts of the world economic crisis together with drift towards incessant increasing of competitiveness cause the effect of market concentration, forced company merger or different forms of near international cooperation. Cooperation and perspectives of new occasions in the logistics area bring also new technologies. Communication of different systems and platforms require standardization of given information. Full introduction of RFID in the world can bring considerable finance and environmental savings.

Another important theme in given area may be the development of supply chains in the Slovak Republic and its specifics so as possibilities of diversification of logistics services provider activities in the Slovak Republic. [1-3]

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Impact of Geopolitical Changes on Business Logistics

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Abstract. Political development and economic sanctions resulting from it constantly creates new challenges in the area of business logistics. International logistic companies with global reach can be successful and provide logistic solutions for their customers in this turbulent environment. International trade and logistics form an indivisible unit.

Keywords: geopolitical changes, logistics, transport of goods.

1. Introduction

In the market economy, in which liberalization is being enforced increasingly, a constant verification of transport options and new transport routes is taking place. It's not only caused by the impact of increasing competition in the global shipping market, but also by many other effects related to individual states which are under the pressure of internal, political or economic problems. With the development of new transportation systems, implementation of intermodal transport and the application of logistic principles, the role of transport is increasing not only in the transport process but in the world economy as well.

Along with the gradual increase of international trade, global revenue resulting from it and from activities associated with it are growing too. Individual countries are involved and they support international trade. They use instruments of national economic policy for an immediate exertion on international trade, which leads to strengthening of the competitiveness and productivity of the given country, which allows them to improve the living standards of the population and in some countries even public safety as a response to economic sanctions of political-economic groupings.

In case of goods, the export and import from and into a country is associated with its movement, i.e. with international transport. The method and quality of transport may have a significant overall affect on the effect of the foreign trade operation, not only by increasing the prices of goods depending on transport costs.

2. Analysis of the current state of EU economy

The global economic development has also an effect on the economic development of the EU. Countries of EU are amongst the most important commodity exporters in the world. The overall share of EU countries on world export of goods is currently around 32 % (data for the year 2012 from the World Trade Organization, hereinafter WTO). If we separate internal and external trade of the EU, then the share of EU countries on world export of goods is around 12%. Countries of the EU 27 exported in the years 2010-2012 goods and services in worth about 17 billion USD. However, the total import into the countries of the EU 27 represented in the years 2010 to 2012 the amount of 17.6 billion USD.

The share of European countries on the global trade is 35 % and the EU 27 itself is 32 %, import into Europe constitutes 36 % and the EU 27 is 33 %.

More than two-thirds of export do not leave the EU (about 63 %), it is the trade within the Member States, approximately 8 % of export goes into North America, 6 % of the export into other European countries, 3.7 % of export into the Community of Independent States/ CIS, especially Russia representing a share of 2.7 %, 9.9 % of EU export goes to Asia, 3.3 % to Africa and 2.7 % exports to the Middle East. The EU export to China in 2012 represented an amount of 184 billion USD. On the other hand, China's export into the EU represents an amount of 411.36 billion USD in 2012, i.e. that China's export into the EU countries is twice as big.

The commodity structure of the international trade of EU is composed of mainly processing products (about 80 % of the turnover of the realized trade exchange), of which about 80 % is directed for export and 70 % for import. Trade with raw materials including oil and natural gas represents about 15 % of the overall amount. EU industry is characterized by high consumption of raw materials, fuel and energy, while domestic production cannot meet the ever increasing demand. Trade with agricultural production is relatively small, about 10 % of the global trade, but its role is indispensable in every economy of the world. It contributes to the stability of the global economy and ensures the sustained growth of the human society. The EU is a major exporter and importer of the commercially provided services, globally. The EU member states are involved in the turnover of the global trade in commercial services, about 45 %. In transport services the EU exports about 43 % of global export and imports about 35 % of the global import, based on the published data of WTO.

Due to the decreased protection of individual markets and the subsequent transfer of a large part of the production capacity from developed to developing countries, the situation changed in favor of developing countries. The share of developing countries (not only BRICS) on foreign trade has been constantly increasing for the past twenty years. Currently, the most significant increase in the share on the global export is in Asia.

The global economic development affects also the economic development of the EU. According to available data for 2011, the EU GDP real growth increased by 1.5 %. The average rate of growth in developed countries should increase from 1.3 % in 2013 to 2.4 % in 2016. Related to that, the forecast of global economy in 2014, and also due to the continuing economic growth of China, positive. The World Bank stated this in its latest report on the development of the global economy (Global Economic Prospects).

The GDP indicator of developing and transition countries, which has increased by 4.8 % in 2013 according to the World Bank, will rise by 5.7 %. in 2016. However, the tempo is slowing down compared to the huge expansion in years 2003-2007. Experts from the World Bank predict a GDP increase of 1.1 % in the EU 27 this year, in the following year 2015 an increase of 1.4 % and in 2016 an increase of 1.5 %.

The analysis shows that the development of the EU economy is heavily influenced by the development in a world markets, especially economic globalization. The main foreign trade partners are (and will be continued) Russia, China and the USA. However, in the context of the current political development there are significant changes in the development of foreign trade between the EU and Russia. Economic sanctions significantly change corporate logistics of European exporters.

On 31st July 2014 the European Union adopted the Council Decision 2014/512 / CFSP and the Council Regulation 833/2014 concerning restrictive measures regarding Russia's actions that destabilize the situation in Ukraine. These new restrictive measures focus on four areas: goods and dual-use technologies for military use or military end-user; sensitive technologies for the oil industry and related industries; import and export of arms and related materiel and access to capital markets.

The mentioned sanctions began to be applied from 1st August 2014. Their implementation will be monitored continuously and according to the situation they may be revised or extended.

The second quarter 2014 showed a fall in the GDP growth in the three largest economies of the EU i.e. in Germany, France and Italy.

On 7th August 2014 a measure of the Russian Federation government came into force by the government decree restricting imports of food and agricultural products from countries that have introduced economic sanctions against Russia. Russian media reported that the embargo would regard products, constituting 10 % of food imports to Russia in a total amount of four billion USD annually. According to published Russian sources imported food and agricultural products worth 43 billion USD are being imported to the Russian Federation annually. Russia banned the import of fruit, vegetables, meat, fish, milk and dairy products from the United States, European Union, Australia, Canada and Norway.

The following Table 1. shows the categories of food imported to the Russian Federation from the EU in 2013.

No.	Cathegory	Amount in mil. EUR
1.	Fruit	1,070
2.	Cheese	985
3.	pork	969
4.	Vegetables	769
5.	Spirits	752
6.	Wine	597
7.	Bakery products and pasta	575
8.	Other unspecified food	496
9.	Food for pets	483
10.	other meat kinds	460

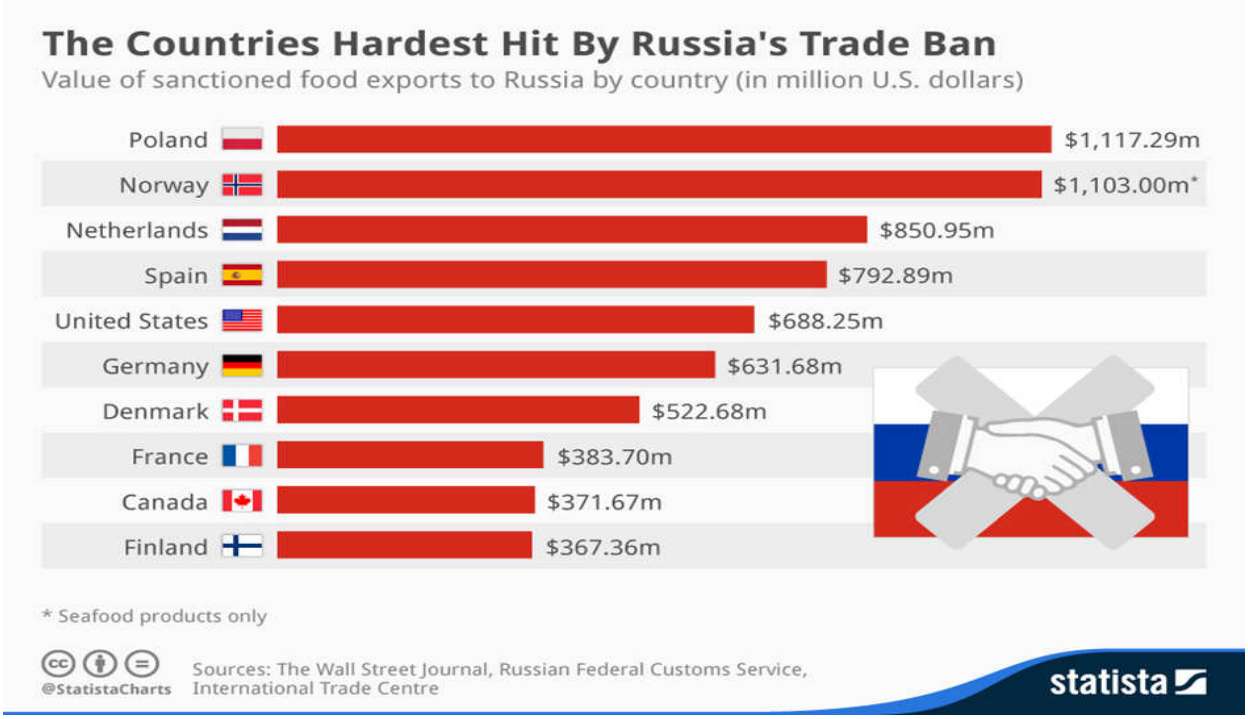
Tab. 1. Ten biggest food category, which are being exported to Russia from the EU (2013), Source: European Commission

According to Sergei Jusino, head of the executive committee of the National Association of Russian meat processing industry, only 10 % of poultry meat is imported (out of which 2/3 are hams from the USA). Key suppliers of pork and beef into the Russian Federation are Brazil, Paraguay and Canada.

In 2013, meat worth 6.7 billion USD that was imported into the Russian Federation. Out of the countries affected by Russian sanctions, the biggest import was especially from Denmark (6.6 % of the total), Germany (6.4 %), the USA (5.3 %) and Canada (3.8 %).

The Russian Federation can have a big problem with the supply of cheese. According to the USDA (United States Department of Agriculture) was the cheese consumption last year in Russia at the level of 794 thousand tons, while imports was 46%. Most often they imported from the EU.

Based on the calculations of economists the Russian embargo on food import from Europe will cost the European suppliers of € 6.7 billion in cash. Due to the sanctions 130 thousand Europeans will lose their jobs. Poland will suffer the most at losing of jobs. In France, Spain and Italy an average of 10,000 people may lose their jobs.



Picture 1: Countries most hit by Russia's trade ban (in mil. Of USA)

Based on the current situation exporters (farmers, food producers) are looking for new ways of logistics security for their sales despite an increase of the logistics costs. European companies are changing logistics chains, looking for a way to circumvent the Russian embargo on import of fruit and vegetables, meat, fish and dairy products from the European Union and Norway, which also apply to the production in Canada, USA and Australia.

Solutions are based on the fact that sanctions of the Russian Federation formally apply specifically to the EU and Norway. Therefore, non-EU countries may continue to trade with the Russian Federation. This will change the logistic flow, transport routes and external trade between countries. This applies to Switzerland, Iceland, Liechtenstein, Turkey, Cyprus, Serbia and the Danish Faroe Islands that are not the member states of the EU. Another group are neighboring countries such as Belarus and Kazakhstan, which are form the Russian Federation Customs Union. The fact is proven, that in August 2014 Belarus and other Eastern European countries increased their interest in goods from the EU and European exporters are now considering how to meet the new demand. However, based on the development of shares of logistics companies, there still are logistic companies such as Deutsche Post and Kühne + Nagel who are carefully giving uncertain demand and the fact that sanctions will be in force only temporarily or they can change.

The reason of this may also be the fact that there were disputes between the Russian Federation and Belarus about the violation of the FTA in the past which may also caused this situation.

On the other hand, the re-import of food through Belarus may be a measure of the Russian Federation to mitigate the inflation growth. In the customer "basket" of the Russian Federation food represents the share of 36.5 %. Meat, milk, dairy products and pasta represent the share of 19 % . Goldman Sachs assumes that food prices will rise by an average of 10 % and another 1.2 - 1.5 % will be necessary to add because of the inflation. A large proportion of food is imported, and e.g. the prices of apples are 50 % higher due to the ban on import from the EU. Another possibility for the Russian Federation is the export of food from other countries. They launched negotiations with Argentina, Brazil and Ecuador to ensure the import of sanctioned commodities to the Russian Federation.

In case the Russian Federation and the EU will continue in sanctions, both parties must have an investment plan prepared - for agriculture, but especially for logistics.

Russian logistic experts estimate that if they wanted to build logistic centers linked to local agriculture, the construction of a single logistics center would cost about 250 million EUR. Investments in private sector are questionable because the sanctions may lapse.

However, economic benefits of current developments may exporters and logistics companies have from countries outside the sanctions, such as Switzerland and Turkey. Switzerland rejected attempts of food companies from EU Member States that planned to avoid sanctions of the Russian Federation on food import for the EU member states through is exported from the country. Swiss Federal Office for Agriculture rejected the application of European producers, on the ground that Switzerland has to certificate all food that is exported from the country. The certificates cannot be issued in case of the food that is produced outside of Switzerland.

As an example is the cheese which is Switzerland's most important agricultural product. Swiss cheese producers export about 430 tons of cheese (2013) to the Russian Federation, which is only a fraction of their export worldwide (63,000 tons). This raises the possibility of Swiss cheese producers to replace the export from Italy and the Netherlands with the export to the Russian Federation. Italy, as the producer of mozzarella and the Netherlands and its Gouda and Eidam are in fact among the countries that are prohibited to import certain food into the Russian Federation.

In 2013 Switzerland exported over 20 tons of Intercheese into the Russian Federation. Therefore the Russian- EU sanctions create more possibilities for Switzerland export to the Russian market.

Turkey is another country having advantage of the sanctions. In 2013 Turkey was the fifth largest importer of food into the Russian Federation (1.26 billion EUR). The export of Turkey into the Russian Federation is increasing since the sanctions against EU countries, USA and others came into force. Especially growth of the export of poultry and seafood has been recorded. Turkey is also prepared to meet the increased demand for fruit and vegetables.

Political development and economic sanctions resulting from it constantly creates new challenges in the area of business logistics. International logistic companies with global reach can be successful and provide logistic solutions for their customers in this turbulent environment. International trade and logistics form an indivisible unit.

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Analysis the Importance of Passenger Requirements for Transport Service Quality in Suburban Bus Transport by Geographical Location

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Abstract. Service quality has a large number of criteria. It is a significantly subjective opinion of customer. It is associated with fulfilment or default of the customers' requirements (or expectations). The requirements of customer are changing in the time, they are generally strict. These requirements are different by age of individual customers because it is difference if the passenger is child, student or pensioner. But there is a question if the customers' requirements are different according to geographical location, i.e. according to where the passenger is living. This question is the subject of this article. Why are we dealing with quality of service? Because the service quality is important determinant of demand for public passenger transport.

Keywords: Quality criteria, customer, requirements, service, public transport.

1 Introduction

We can describe the service quality of public transport with criteria which are achieving the certain level i.e. to determine the qualitative limits which public service provides. Service quality is most often associated with fulfilment or default of requirements and expectation the customers. The overall quality of public passenger transport contains a lot of criteria. The criteria represent the customer view of the provided service.

The operator, and public authority should identify these requirements of passengers and should meet these requirements with regard to the sustainability of passenger demand for public transport services. The reason for the fulfillment of the requirements is that passenger demand for public transport is significantly affected with service quality.

It is important to say that, the quality requirements are constantly changing (mostly getting more tighten). Therefore it is necessary to review these requirements after a certain time.

The structure of passengers changes as well as the requirements of passengers. There is an assumption that different group of passengers have different quality requirements. There will be another importance for example in criterion "access to internet" for passenger in the age 16-19 and another for passenger over 65 years.

The subject of this article is to detect whether the quality requirements change with respect to geographical location. The aim is to determine whether the quality requirements are different according to the part of Slovakia where the passenger lives or regularly travels. The importance of customer quality requirements is reviewed on bus lines in 5 self-governing regions in Slovak Republic. The research continues on other self-governing regions of Slovakia, as well as for greater number of respondents.

2 Legislation in the area of quality in public passenger transport in Slovakia

Quality in public passenger transport solves *Act No 56/2012 Coll. on Road Transport*, *Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road* (taken

from European law) and two European standards apply in the all EU: *STN EN 13816* - Transportation. Logistics and services. Public passenger transport. Service quality definition, targeting and measurement and *STN EN 15140* - Public passenger transport – basic requirements and recommendations for systems that measure delivered service quality.

2.1 Quality requirements in Act No 56/2012 Coll. on Road Transport

In §21 (Service contract) in article 1 of this Act states that the purpose of the service contract is to ensure the public safety, effectiveness and quality of services for determined basic tariff and in adequate performance based on needs the transport serviceability of region. It is also necessary to consider the social and environmental factors and the objectives of regional development. The service contract is concluded between the public authority and the operator of transport services in regular transport for transport services which the operator would not provide at all because their economic disadvantages or which he would not provide in determined range or in quality or for determined basic tariff. The service contract is important because these transport services are necessary for transport serviceability of region.

Article 9 of this Act adds that part of this contract are the requirements for quality (i.e. STN EN 13816 and STN EN 15140) and security standards of regular transport in public interest as well as technical standards relating to transport of passengers with disabilities and reduced mobility, and requirements for age, equipment and technical level of buses.

2.2 Quality requirements in Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road

The purpose of this Regulation is to define how, in accordance with the rules of Community law, competent authorities may act in the field of public passenger transport to guarantee the provision of services of general interest which are among other things more numerous, safer, of a higher quality or provided at lower cost than those that market forces alone would have allowed.

The Regulation lays down the conditions under which competent authorities, when imposing or contracting for public service obligations, compensate public service operators for costs incurred and/or grant exclusive rights in return for the discharge of public service obligations.

2.3 STN EN 13816 - Transportation. Logistics and services. Public passenger transport. Service quality definition, targeting and measurement

This standard defines 8 quality criteria:

- *availability:* extend of the service offered in terms of geography, time, frequency and transport mode;
- *accessibility:* access to the PPT (Public Passenger Transport) system including interface with other transport modes;
- *information:* systematic provision of knowledge about a PPT system to assist the planning and execution of journeys;
- *time:* aspects of time relevant to the planning and execution of journeys;
- *customer care:* service elements introduced to effect the closest practicable match between the standard service and the requirements of any individual customer;
- *comfort:* service elements introduced for the purpose of making PPT journeys relaxing and leasurable;
- *security:* sense of personal protection experienced by customers, derived from the actual measures implemented and from activity designed to ensure that customers are aware of those measures;
- *environmental impact:* effect on the environment resulting from the provision of a PPT service.

Service quality loop

The quality system can be described with service quality loop (Figure 1) which evaluates the delivered service from the customer view as well as from service operator view. Individual aspects of quality are closely related. The objective is to minimize differences between expected and provided quality.

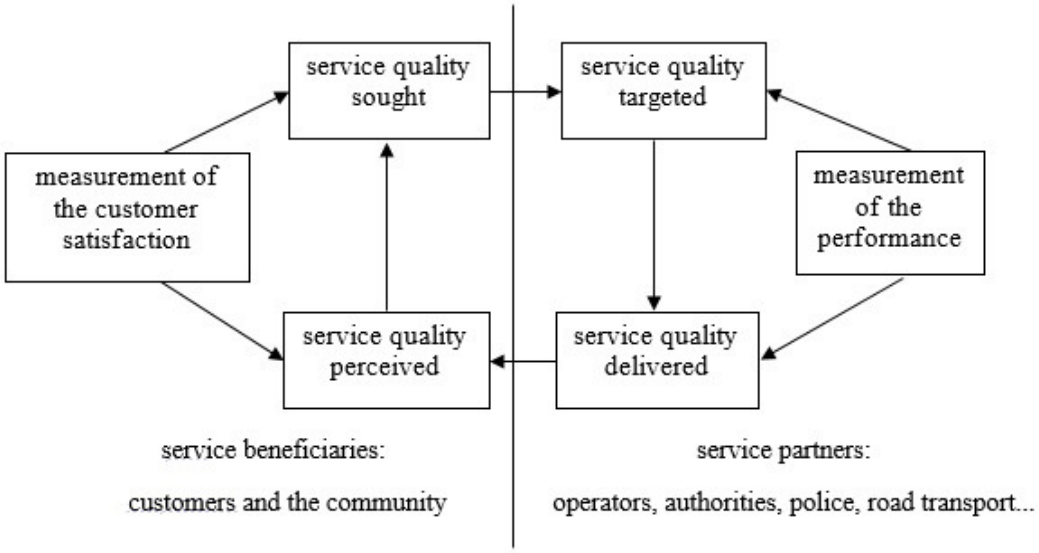

Fig. 1. Service quality loop

2.4 Strategy of development of public passenger transport and non-motorized transport of Slovakia 2020

Strategy of development of public passenger transport and non-motorized transport of Slovakia 2020 is strategic document which deals with quality of PPT in the Slovak Republic. This document was published by the Ministry of Transport, Construction and Regional Development in June 2014. It includes Annex A "*Strategy of development of public passenger transport in SR 2020*", which deals with the quality and quality standardization of public transport services in the Slovak Republic. The objective of the Strategy is to achieve higher ratio in the modal split in public passenger transport and in non-motorized transport.

3 Identification of customer quality requirements in suburban bus transport in Slovak Republic

It is an expected quality level. The indicator says about the level of customer requirements which should be on the basis of their legitimacy. Analyzes were made on the basis of the weighted arithmetic average. In the table below (Tab. 1), it can be seen the selected customer quality requirements by bus lines in self-governing regions in Slovakia regardless of age the customers. These requirements are arranged in descending. Analyzes of individual bus lines by age of customers did not fit into the scope in this article. The questionnaire was created for verification of ability or suitability the research. The questionnaire was used for the sample of 1 880 people.

Žilina	Banská Bystrica	Trenčín	Bratislava	Košice
punctuality	punctuality	punctuality	punctuality	punctuality
actual, available and readable time table	behavior of staff	frequency	behavior of staff	continuity
information	continuity	speed transport	frequency	cleanliness of bus
identification of bus	climate/ heating in the bus	actual, available and readable time table	driving technique of driver	information
driving technique of driver	speed transport	behavior of staff	climate/ heating in the bus	frequency
climate/ heating in the bus	the possibility to sit in the bus	the possibility to sit in the bus	actual, available and readable time table	actual, available and readable time table
sitting area and shelter in the bus stop	frequency	identification of bus	the possibility to sit in the bus	driving technique of driver
continuity	cleanliness of bus	cleanliness of bus stop	cleanliness of bus	climate/ heating in the bus
frequency	driving technique of driver	cleanliness of bus	sitting area and shelter in the bus stop	access to internet
behavior of staff	actual, available and readable time table	sitting area and shelter in the bus stop	access to internet	internal light in the bus
cleanliness of bus	access to internet	continuity	speed transport	the possibility to sit in the bus
internal light in the bus	identification of bus	climate/ heating in the bus	cleanliness of bus stop	identification of bus
impact on the environment	sitting area and shelter in the bus stop	driving technique of driver	identification of bus	behavior of staff
the possibility to sit in the bus	cleanliness of bus stop	access to internet	impact on the environment	cleanliness of bus stop
cleanliness of bus stop	information	impact on the environment	continuity	sitting area and shelter in the bus stop
access to internet	internal light in the bus	information	internal light in the bus	speed transport
speed transport	impact on the environment	internal light in the bus	information	impact on the environment

Tab. 1. Importance of selected customer quality requirements by self-governing region in Slovakia regardless of age the customers which are arranged descending

In the graph below (Fig. 2), it can be seen the customer quality requirements from table 1 which are arranged by individual quality criteria.

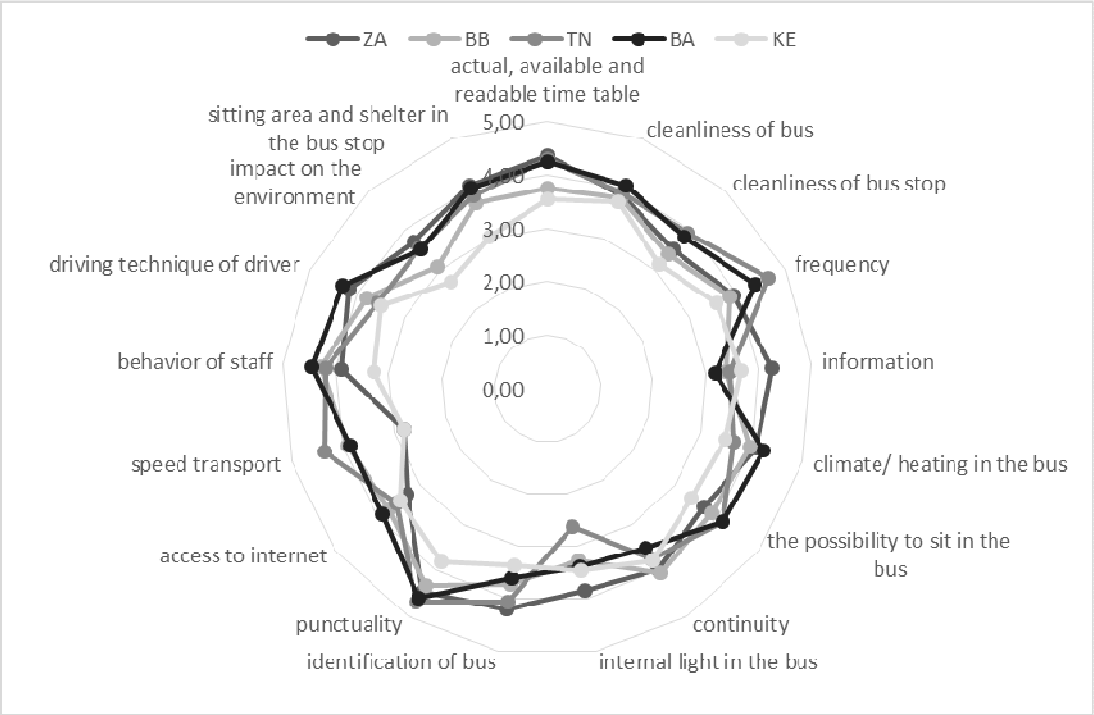

Fig. 2. Importance of selected customer requirements by self-governing region in Slovakia regardless of age the customers

This graph shows 17 quality criteria. As it can be seen, the importance of individual quality criteria is almost the same in self-governing regions. Customers in Bratislava a Žilina self-governing regions had the strictest quality requirements (in the 5 points). The lowest importance of the quality criteria had self-governing region Košice.

The quality criteria “speed transport”, “frequency”, “impact on the environment”, “internal light in the bus” and “behavior of staff” had the biggest difference in importance of customer requirements. The quality criteria “cleanliness of bus” and “continuity” had the biggest unity in importance of customer requirements.

4 Conclusion

Demand for public passenger transport is affected by the quality of service. Service quality is most often associated with requirements and expectation of customers. The main goal of operator should to identify the requirements of passengers and then, with regard to the sustainability of passenger demand for public transport services, meet these requirements the best he knows. It is important to research the passenger requirements by age of passengers because there are the differences in the passenger requirements by their age. The geographical location has not the influence on the customer requirements. As we can see in the research of bus lines in the Slovak Republic, passengers ascribe more or less the same importance for individual quality criteria. The quality requirements are constantly changing. Therefore we have to constantly review them.

But it is important to remember that the customer requirements are not the only factor witch determine the quality standard. It is important to take account legal, political, technical, financial and other restrictions.

Acknowledgement

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University of Žilina, Žilina, Slovak Republic

Database as a Tool for Analyzing Technical Condition of Offshore Industry Objects on an Example of Fishing Vessels

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Abstract. The paper presents a relational database allowing for an analysis of the current technical condition of offshore industry objects on an example of fishing vessels. Vessels' technical and operational data, entered into the base, with an option of updating on current basis, may be used to generate any queries and reports in order to use them to perform a statistical or optimization analysis and an assessment of the technical condition and determination of modernization direction.

Keywords: ship power systems, fishing cutters, energy efficiency.

1. Introduction

The provisions of the Montreal Protocol developed and agreed in 1987 by the United Nations Environmental Programme implement the requirement that the refrigerating substances which deplete the ozone layer should be withdrawn from use and production. The Protocol imposes simultaneously a requirement that alternative refrigerants should be introduced.

Fishing vessels, with particular emphasis on refrigeration systems that are currently in operation, require thorough modernization due to the need to use refrigerants with lower ozone depletion potential (ODP). In particular, the following should be changed: refrigeration compressors due to the failure to adjust the power, pipelines due to other physical and chemical properties of new refrigerants types, instrumentation elements due to the change of the pitch range.

Simultaneously, the results of the international research have shown that the most important impact on the environment has greenhouse gas emissions. As a result of the research was the adoption and implementation of Kyoto Protocol in 1997 which includes recommendations to minimize and reduce greenhouse gas emissions to the atmosphere (inter alia carbon dioxide). Refrigeration systems are responsible for generating carbon dioxide and for refrigerants leaks during their operation. A result of estimating combined effects of different types of emissions on the global warming, during the entire life of the system, is the TEWI indicator. The most important parameter of the indicator is so called energy element. Therefore, it is essential to specify the power required by refrigeration equipment in the balance of the whole power plant.

A complex assessment of technical conditions of fishing vessels, which are currently in operation, is a primary goal as well as the determination of the scope of the required modernization based on the assessment.

A large number of vessels operating in the Polish fishing fleet necessitated the need to create an interactive system, allowing a user to obtain information helping to make a decisions on potential modernisation.

2. Data collection method

The data collected and entered into the base refers to more than 900 fishing vessels which are operated in Poland. The catalogue includes both small fishing cutters, 4 m long, fishing boats of the length of 20-25m, and big trawlers [1,2,6].

Measuring teams, delegated to a particular vessel, carried out its inventory, collecting every possible technical and operational data. The information was grouped in a several categories.

The data was completed as a result of obtaining information from shipowners and vessels' operators and repair companies. The information was provided in the form of filled questionnaires and interviews performed on the selected vessels and also on the grounds of an analysis of the operational documentation for each vessel selected, including inspections, maintenance and current repairs in 2007-2014. For each vessel a record card was developed with an individual number. The information collected by that means was entered into the base. In case of potential vessel modernisation, the administrator may modify the data.

Due to the cooperation between the Maritime University, the Maritime Office in Szczecin, shipowners of fishing vessels, repair companies, in particular with the shipyards in Kołobrzeg and Ustka, the database in updated on a regular basis [1,3,5].

3. Interactive database

An application developed in the form of a relational database is dedicated for detailed inventory and for an analysis of the existing fishing fleet in terms of the requirements imposed by the European Union, especially both construction and operational parameters (inter alia technical condition of refrigeration systems which current technical condition differs from the theoretical one) [4,5,7,8].

The system is composed of two modules created in object-oriented programming system JAVA (Fig.1):

- server – data management system;
  client – enters data, edits and processes data in the base

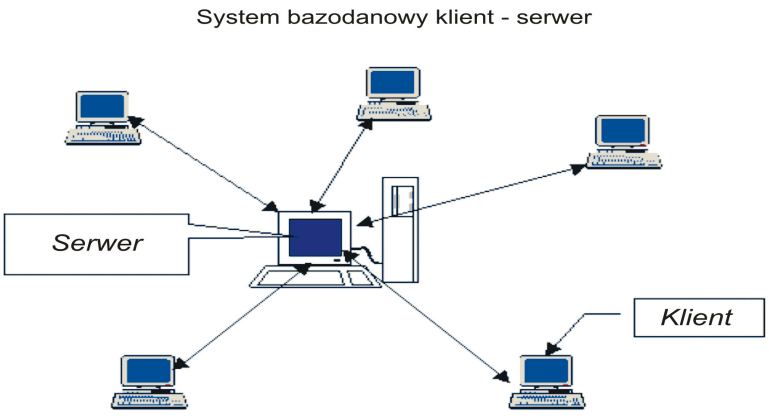

Fig. 1. Application lock diagram client-server model .

The developed system is a PostgreSQL database system. Its advantages are:

- Possibility to install it on any hardware platform without the need to update the operational system.
- There is no requirement to purchase a server license.
- There is no requirement to purchase a client license.
- Unlimited number of users.
- Multiplatform – it is possible to install it on various operational systems and equipment.

Due to JAVA the client's software may use any hardware platforms and operational systems, at minimum equipment configuration, and the base may accessed from any computer that is connected to the Internet. However, it requires granting permissions (establishing an account) by a system administrator.

The system may be operated:

- On a single workstation.
- On a server in the network with local access.
- On a server with an access of selected departments.
- On the ends with periodical data updates.

The application is characterised by:

- Low implementation costs.
- Immediate response to the required changes in the system.
- The product is Polish in its entirety.
- All advantages of a PostgreSQL database motor .

The software is an interactive application, communicating with a user through a number of various information windows. This significantly facilitates its operation. Additionally, context-sensitive help was implemented into the software. The main window is modeled on Windows. The user may find three basic modules the basic functions of which are activated depending on the user granted permissions:

- main menu – allows for using all available software functions (Fig. 2);

Fig.2. Main menu.

- a tree presenting catalogued vessels – allows for displaying all or selected vessels using any query, sorting according to a selected filter e.g. shipowner name or registration number. Selecting a vessel with the cursor causes that the record of that vessel is downloaded from the base and every field in the information window is filled. The tree has a context menu (Fig. 3) allowing for adding or removing technical specifications and descriptions of vessels and sorting and creating queries.

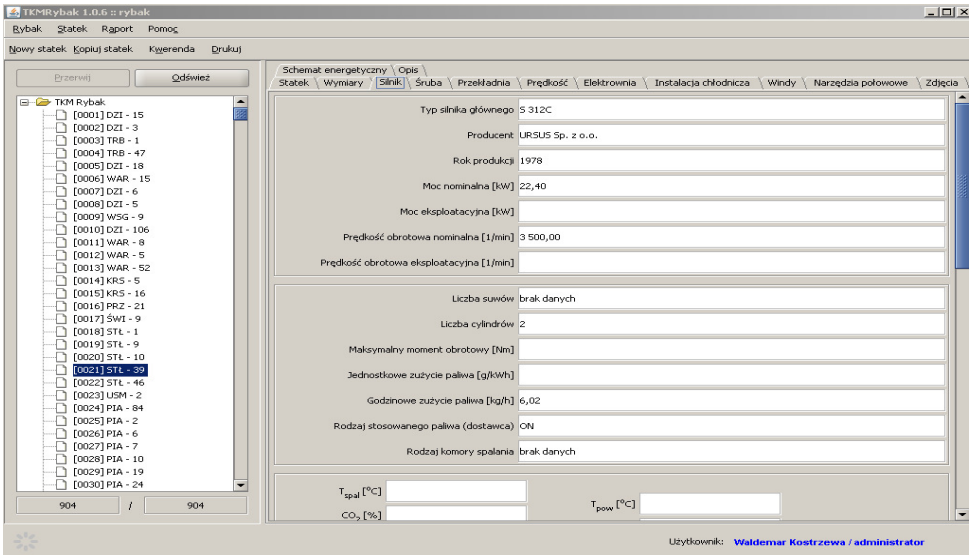

Fig.2. Main window

- Information window (Fig. 4) – consisting of 13 theme tabs representing the following vessel characteristics:

- Basic information (ship name, shipowner, homeport, shipyard, construction year, shipyard designation)
- Dimensions (length, width, load capacity);
- Technical data of engine, propeller, gear and power plant;
- Information on speed in various sailing states;
- Refrigeration system specification;
- Trawl winches, anchor capstan winches, mooring winches at the vessel;
- Fishing gear;
- Energy block diagram;
- Images;
- Notes and comments.

The data referring directly to the refrigeration system include (Fig. 4.):

- Type of refrigeration system,
- Refrigerant,
- Compressor type,
- Producer,
- Production year,
- Input power,
- Cooling capacity.

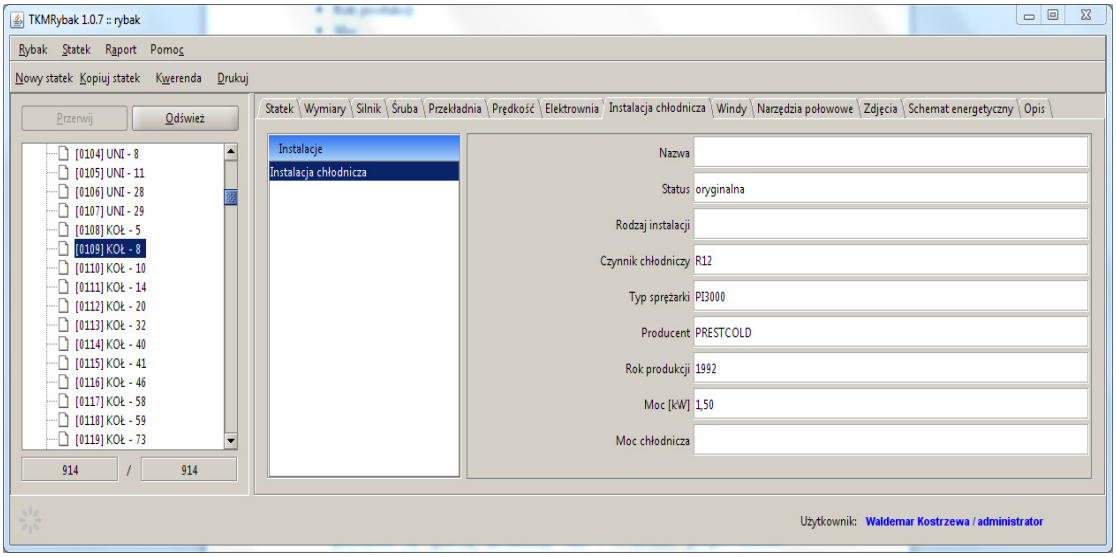

Fig.2. Information window – information on the refrigeration system on the particular fishing vessel

The software includes also autonomous modules for collecting restricted information on personal data regarding shipowners and producers, along with contact data:

- Shipowners' management,
- Producers' management.

It allows for fast and efficient database update and, if possible, for performing additional research as per a shipowner's request.

Depending on the permissions granted the application allows also for:

- Entering and editing data, in particular adding base units, their modification and deletion, and importing images.
- Obtaining information from the software using queries and report and their print out. It is possible to analyze entered units due to developed query mechanism. However, the queries implemented into the software are: sorting, conditional and result queries

4. Conclusion

It was managed to create an application in the form of a relational database which allowed for developing a catalogue of all fishing vessels in Poland. The module of "client" type allows for connecting with the base from any PC having a connection to the Internet, including security system implemented to the base preventing unauthorized access [1,2,3].

The database system is an interactive software of bidirectional information exchange between a PC and the user. The dialog is conducted using various information windows and messages. The data obtained due to queries, exported in PDF and txt format, may be consequently used for statistic analysis and for optimization procedures (e.g. selection of optimum operation parameters for refrigeration system), and in particular they may become an integral part of an expert system determining an optimal direction in the scope of a vessel modernisation.

On the grounds of all the information in the database (including vessel size, fishing area, fishing gear, information on the main engine, winches and power plant), a decision may be made in terms of partial modernisation or total change of structural issues of refrigeration system taking onto consideration power required by refrigeration equipment in the entire power plant. The parameter is significant when TEWI indicator is assessed in order to compare how various refrigeration systems affect global warming.

The demand for power and a supply method to the system determine the value of so called energy element, which will be crucial when refrigerant has zero potential impact on the global warming or the system is totally leakproof and the filling and recovery methods eliminate all and any leaks to the atmosphere.

Recommendations regarding the modernsation of the vessel, with particular attention to its refrigeration system, suggested upon the analysis of a current condition, may be entered into the database in the form of comments dedicated for the particular vessel. Then, upon the verification process of the comments' introduction, they are entered into the database as an update.

Similar databases may be created for any type of the offshore industry objects with modifications including the characteristic of their structure and operational tasks.

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The Drivers' Perception of Intelligent Transport Systems

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Abstract. In the transport process, it is necessary to combine several strategic goals to provide transport services according to its users' needs. Increasing of safety on the roads is process which tries to mitigate the negative impacts of traffic accidents. The application of Intelligent Transport Systems is important to keep a sustainable development and to increase traffic safety, which is based on collecting, processing, evaluating and distributing the traffic information. Information and communication technologies create the base of transport telematics systems, which include information about the transport process and transport users. The decrease of traffic accident rates can be achieved by informing drivers and other users of transport sufficiently.

Keywords: Intelligent Transport Systems, Questionnaire survey, Traffic management

1. Introduction

The drivers' voluntary acceptance of information is important for traffic management, using Advanced Traveler Information Systems and because of this fact the credibility of provided information is very important. With Intelligent Transport Systems, it is possible to reduce traffic accident rates and to contribute drivers' comfort during travel. [1, 2]

The White Paper on Transport- Roadmap to a single European transport area- towards a competitive and resource-efficient transport system, places particular attention to road safety issues. The European Commission has set the reduction of road transport fatalities by 50% compared to 2010 for the years 2011 to 2020 as a priority. The main aim of the Slovak transport policy is to reduce the number of traffic accidents and to increase road safety. The National plan of the Slovak republic for road safety should create a support for transport policy to meet the aim of period 2011-2020. A part of this plan is also the application of Intelligent Transport Systems in road transport. Figure 1 shows the decrease in the number of traffic accidents in the Slovak republic over the last ten years. [4]

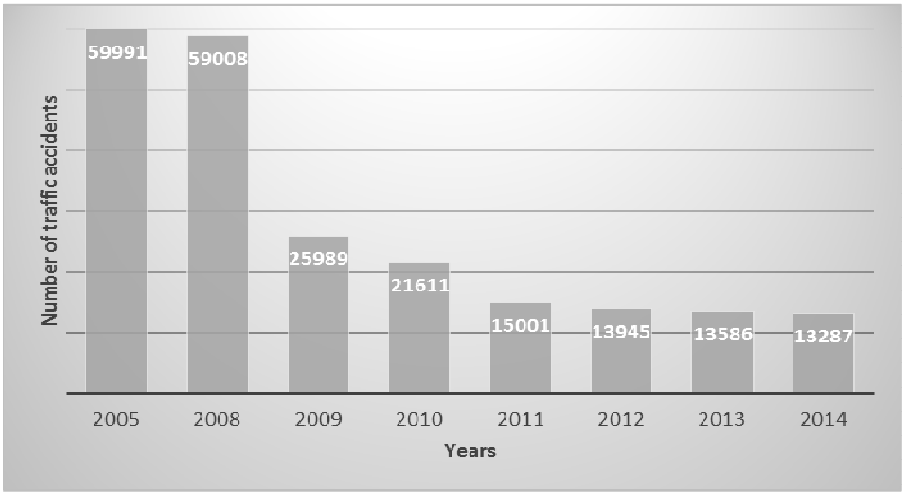

Fig. 1. Number of traffic accidents in the Slovak republic

2. Analysis of drivers' perception of Intelligent Transport Systems

In general, Slovak drivers are not informed sufficiently about the possibilities of obtaining traffic information and using ITS. It is necessary that ITS will become to known to the general public. Since to the aim of this research is to find out how drivers perceive the establishment and the development of Intelligent Transport Systems, a questionnaire survey has been performed. [3]

The minimum sample was determined with help of „ Sample size calculator", which is used to determine how many people you need to interview in order to get results that reflect the target population as precisely as needed. This calculator is available at the internet. For this survey the confidence level was 95 %, the confidence interval was 5% and population was 98787 of drivers registered in the city of Žilina; the result of those parameters is that minimum 383 samples are needed, as shown in figure 2.

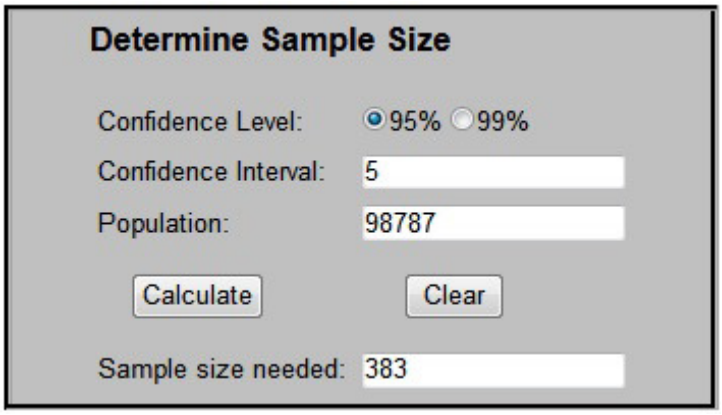

Fig. 2. Sample size calculator to calculate minimum sample

In the survey 519 respondents were participated, including 192 women and 327 men, so the results better reflect the target population.

Each driver, when choosing her/his route, prefers the one which best suits her/his needs and criteria. The basic criteria for selecting the most appropriate route are fuel consumption, travel time to destination, distance between origin and destination, risk of traffic accidents, etc. Table 1 shows the weighted arithmetic averages of the importance of individual criteria which are also shown graphically in figure 3. The most important criterion for men is quality of road infrastructure. For women the most important criterion is travel time to destination.

Criteria	Men 18-26	Men 27-65	Women 18-26	Women 27-65
Fuel consumption	3,59	3,52	3,10	3,75
Travel time to destination	3,79	3,95	3,96	4,13
Distance between an origin and a destination	3,27	3,39	3,40	3,75
Quality of a road infrastructure	3,80	3,97	3,90	4,13
Risk of a congestion	3,48	3,66	3,42	3,50
Risk of a traffic accident	3,23	2,71	3,52	3,69

Tab. 1. Weighted arithmetic averages of criteria evaluation for choosing route

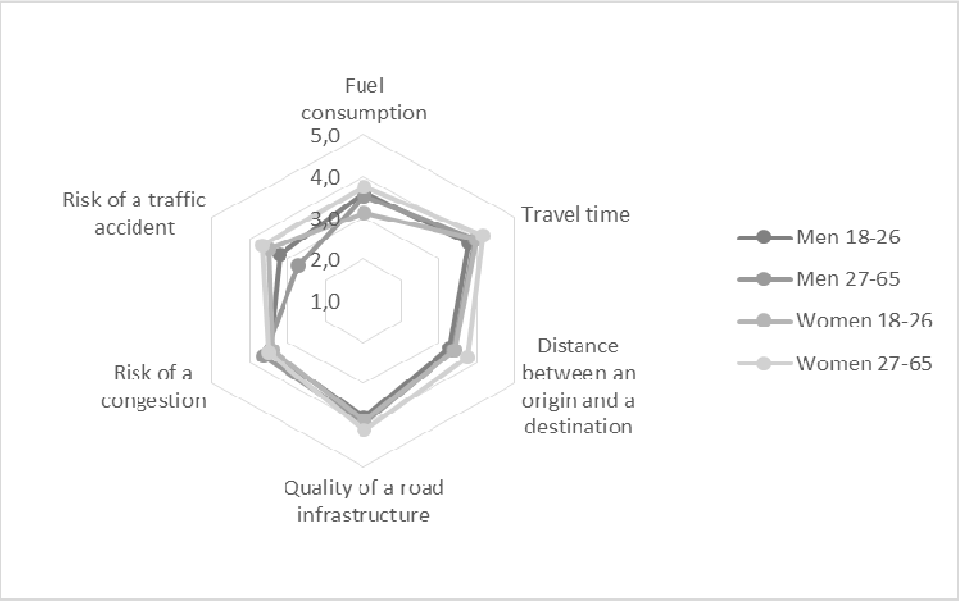

Fig.3. Criteria evaluation for choosing route

When planning trip, it is useful to have actual traffic information which the driver can obtain before travel or during the travel, through information technologies. The most frequently reported way to obtain traffic information according the survey is radio, which is used by 48% of respondents and internet, which is used by 24% of respondents (fig.4.).

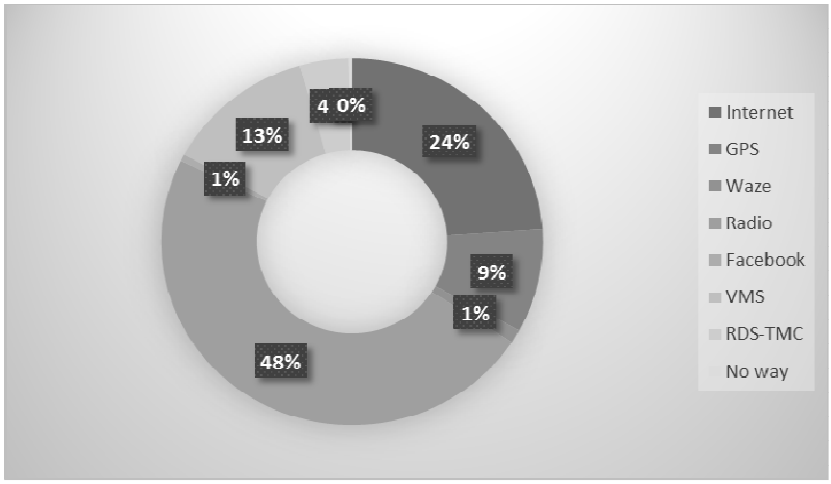

Fig. 4. Ways of obtaining traffic information

The next question was related to whether drivers would expect Intelligent Transport Systems to alert them about a possible danger and which of dangers they assign as the most important ones. The importance of warning to various danger traffic situations from both the women's and also from the men's point of view was analysed. The survey shows that women consider as the most important to be aware of a black ice and the least of a blind road. Men consider as the most important to be aware of a traffic accident and a black ice and the least of a blind road and a one-way road (Tab.2). The survey's results are presented graphically in Fig. 5.

Traffic situations	Men 18-26	Men 27-65	Women 18-26	Women 27-65
Blind intersection	3,01	2,97	3,33	3,38
One- way road	2,69	2,89	3,06	3,06
Changes in traffic organisation	3,56	3,87	2,62	4,19
Sharp bend	2,99	3,08	3,35	3,13
Blind road	2,35	2,71	3,69	2,75
Traffic accident	4,20	4,37	4,04	4,25
Congestion	3,96	4,24	3,71	4,63
Black ice	4,18	4,53	4,29	4,94
Fog	3,17	3,61	3,83	4,69
Strong wind	2,76	3,42	3,40	4,44
Heavy rain/ snow	3,15	3,68	3,83	4,50

Tab. 2. The evaluation of warnings' importance of traffic situations

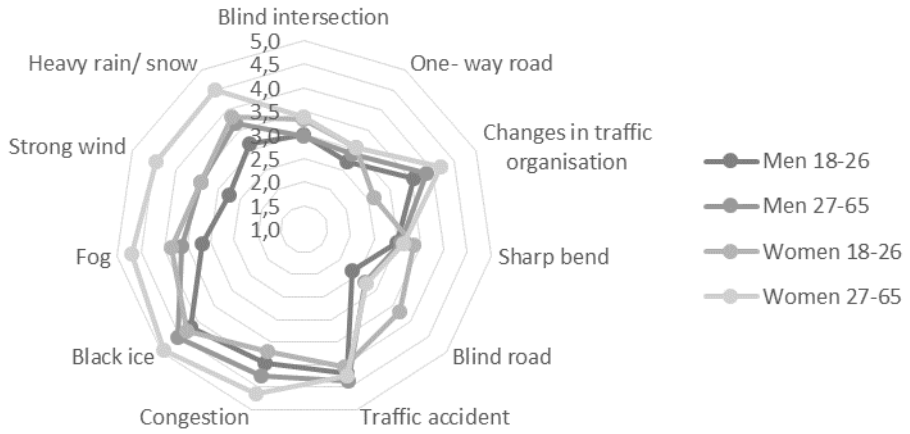

Fig.5. The evaluation of warnings' importance of dangerous traffic situations according to gender and age of respondents

The overall analysis of the questionnaire shows that drivers are open to the new possibilities of ITS use, especially to increase their own safety during travel.

3. Conclusion

An increase of individual vehicle transport is observed on the roads in Slovakia. The result is that traffic volumes in the cities and also outside the cities are still increasing, which leads to congestions and traffic accidents. The main goal of Slovakia's transport policy is to decrease the number of traffic accidents and to increase road safety levels. The National Plan of the Slovak republic for road safety in period 2011 – 2020 should help to achieve this goal. The Plan also includes the application of Intelligent Transport Systems in road transport. The Slovak republic is still at the beginning in the field of ITS use, compared to other countries. [2]

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Designing of Large Emergency Service Systems Using IP-solvers

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Abstract. This paper deals with the optimal resource location problems used for emergency service systems designing. Due to limited budget or other resources, particular mathematical models usually take the form of the weighted *p*-median problem. To obtain the optimal solution of studied problems, the universal optimization environment XPRESS-IVE can be used. If a large instance is described by a location-allocation model, then the model size often exceeds any acceptable limit for available optimization software. The main goal of this study is to present and compare two different modelling strategies. The first one follows the idea that only one nearest located service center can be taken as a source of individual user´s disutility. In the second strategy more centers are considered. Both approaches are based on a radial formulation of the problem, which was developed for effective solving of large instances.

Keywords: Location, weighted *p*-median problem, radial formulation, generalized disutility, XPRESS

1. Introduction

Large instances of the weighted *p*-median problem and associated solving approaches form a background of many public service system design problems where the quality criterion takes into account the average distance, or generally some form of disutility, between served users and the nearest source of provided service [2], [4]. Particular location-allocation models of these problems are characterized by big number of possible service center locations which can take the value of several thousand [1]. Concerning the problem size it is obvious that attempts at exact solving usually fail due to enormous computational time or memory demands. To avoid difficulties with the solvability of real instances, a radial formulation has been introduced [4], [6]. This approach is based on a specific model reformulation, which may cause a little loss of solution accuracy, but it enables us to solve real instances in admissible time using common optimizations software tools.

When a real public service system, like an administration system, is designed using means of mathematical programming, it is mostly assumed, that each user is serviced by the nearest located service center. This assumption is commonly used, when the weighted *p*-median problem is formulated. Nevertheless, this simplification does not hold when an emergency system is designed due to stochastic character of real system. Therefore two different modelling strategies are studied and compared in this paper. The first of them follows the idea that only one nearest located service center can be taken as a source of individual user´s disutility. In the second strategy more service providing centers are considered [5], [9]. The main goal of this study is to compare the resulting system designs for different number of service providing centers for each user and try to find out, whether the difference between particular solutions is significant or negligible. The comparison is performed for real data obtained from the road network of Slovakia.

2. Basic Radial Model of the Weighted *p*-Median Problem

To formulate the basic weighted *p*-median problem with the first studied modelling strategy, we denote the set of serviced user locations by J and the set of possible service center locations by I. The number of individual users located at the user location $j \in J$ is denoted as b_j. The disutility for a user at the location j following from the possible center location i is given by d_{ij}. Under assumption

that the user's disutility originates only from the nearest located service center, the problem can be stated as follows: determine at most p locations from the set I so that the sum of the disutility values from each user to the nearest located service center is minimal.

The radial model can be formulated by further introduced variables. The variable $y_i \in \{0, 1\}$ models the decision about the service center location at the place $i \in I$. The variable takes the value of 1 if the center is located at i, and it takes the value of 0 otherwise. The radial formulation is based on the idea of upper or lower approximation of the individual user´s disutility. To obtain an upper or a lower bound of the original objective function, the range $[d_0, d_m]$ of all possible m+1 disutility values $d_0 < d_1 <\ldots< d_m$ from the matrix $\{d_{ij}\}$ is partitioned into v+1 zones. The zones are separated by a finite ascending sequence of so-called *dividing points* $D_1, D_2 \ldots D_v$ chosen from the sequence $d_0 < d_1 <\ldots< d_m$, where $0 = d_0 = D_0 < D_1$ and also $D_v < D_{v+1} = d_m$. The zone s corresponds with the interval $(D_s, D_{s+1}]$. The length of the s-th interval is denoted by e_s for $s = 0 \ldots v$. In addition, auxiliary zero-one variables x_{js} for $s = 0 \ldots v$ are introduced. The variable x_{js} takes the value of 1, if the disutility of the user located at $j \in J$ from the nearest located center is greater than D_s and it takes the value of 0 otherwise. Then the expression $e_0x_{j0} + e_1x_{j1} + e_2x_{j2} + \ldots + e_vx_{jv}$ constitutes an upper approximation of the disutility d_{j*} from the user location j to the nearest located service center. If the disutility d_{j*} belongs to the interval $(D_s, D_{s+1}]$, then the value of D_{s+1} is the upper estimation of d_{j*}. Let us introduce a zero-one constant a_{ij}^s for each triple $[i, j, s] \in I \times J \times \{0 \ldots v\}$. The constant a_{ij}^s is equal to 1, if the disutility d_{ij} between the user location j and the possible center location i is less or equal to D_s, otherwise a_{ij}^s is equal to 0. Then the radial-type weighted covering model can be formulated according to [6] as follows:

$$\textit{Minimize} \qquad \sum_{j\in J} b_j \sum_{s=0}^{v} e_s x_{js} \tag{1}$$

$$\textit{Subject to}: \quad x_{js} + \sum_{i\in I} a_{ij}^s y_i \geq 1 \quad \textit{for } j \in J,\ s = 0, 1, \ldots, v \tag{2}$$

$$\sum_{i\in I} y_i \leq p \tag{3}$$

$$x_{js} \geq 0 \quad \textit{for } j \in J,\ s = 0, 1, \ldots, v \tag{4}$$

$$y_i \in \{0, 1\} \quad \textit{for } i \in I \tag{5}$$

The objective function (1) gives the upper bound of the sum of original disutility values. The constraints (2) ensure that the variables x_{js} are allowed to take the value of 0, if there is at least one center located in radius D_s from the user location j. The constraint (3) puts a limit p on the number of located facilities. Even though the variables x_{js} can take only the value 0 or 1, the integrality property of the model enables the constraints (4) to be in such form.

3. Radial Model with Generalized Disutility

As we have mentioned in the Section 1, presented model (1) – (5) can be used, if the structure of a public administration system is designed, but the assumption of only one service providing center for each user does not hold, when an emergency service system is designed due to random occurrence of the demand for service and limited capacity of the service centers. Therefore, we have studied another modelling strategy, which is based on the following idea: At the time of the current demand for service, the nearest service center may be occupied by some other user. When this situation occurs, the last demand is usually served from the second nearest center or from the third nearest center, if the second one is also occupied. Thus it is obvious that the user may get the service from more than one nearest located service center with different values of disutility [5], [9].

Generally, we use the symbol r to denote the number of service centers, which contribute to the total system disutility of any user ($r \leq p$). Furthermore, to formulate the general model of the user´s disutility, we need to introduce the function Φ: $R^n \rightarrow R^n$, which maps the n-tuple X of real values (x_1, x_2 ... x_n) on the n-tuple of the same real values ordered increasingly. Thus the component $\Phi_1(X)$ represents the smallest value of x_1, x_2 ... x_n. Based on these assumptions, we can define the total system disutility DU_j of the user located at j according to the formula (6).

$$DU_j(I_1) = \sum_{k=1}^{r} \phi_k(d_{ij} : i \in I_1) \tag{6}$$

In the expression (6), the symbol I_1 denotes the set of located service centers (I_1 is a subset of I, where at most p indexes i from I are included) and the constant d_{ij} represents the disutility of the user located at j coming from the service center located at $i \in I$.

Since we assume that the user can be served from more than one nearest located service center, the model (1) – (5) requires some changes. Instead of variables x_{js} for each user location j and each zone s we introduce here a triple-indexed variable x_{jsk} for each $[j, s, k] \in J \times \{0 \ldots v\} \times \{1 \ldots r\}$. The variable x_{jsk} takes the value of 1, if the k-th approximated disutility of the user at $j \in J$ from some located service center is greater than D_s and it takes the value of 0 otherwise. Then the expression $e_0x_{j0k} + e_1x_{j1k} + e_2x_{j2k} + \ldots + e_vx_{jvk}$ constitutes an upper approximation of the disutility d^k_{j*} from the user location j to the k-th most suitable located service center. Note, that the total system disutility for any user is defined according to (6) as a sum of partial disutility values from some r located service centers. After this adjustment, we can formulate the radial model as follows.

$$\textit{Minimize} \qquad \sum_{j \in J} b_j \sum_{s=0}^{v} e_s \sum_{k=1}^{r} x_{jsk} \tag{7}$$

$$\textit{Subject to:} \quad \sum_{k=1}^{r} x_{jsk} + \sum_{i \in I} a^s_{ij} y_i \geq r \quad \textit{for } j \in J,\ s = 0, 1, \ldots, v \tag{8}$$

$$\sum_{i \in I} y_i \leq p \tag{9}$$

$$x_{jsk} \geq 0 \quad \textit{for } j \in J,\ s = 0, 1, \ldots, v,\ k = 1, 2, \ldots, r \tag{10}$$

$$y_i \in \{0, 1\} \quad \textit{for } i \in I \tag{11}$$

The objective function (7) gives the upper bound of the total individual users´ disutility values. The constraint (9) puts a limit p on the number of located facilities. The constraints (8) ensure that the sum of variables x_{jsk} over k expresses the number of the service centers in the radius D_s from the user location j, which remains to the number r.

As we have mentioned, the radial formulation of the weighted p-median problem is based on the upper or lower disutility approximation a thus this approach causes a little loss of the solution accuracy. Is must be realized, that the solution accuracy directly depends on the way of zone arrangement. The accuracy can be improved by a convenient determination of *dividing points* which are used in the disutility approximation and define the zones.

4. Selection of Dividing Points

The optimal dividing points D_1, D_2 … D_v are selected by solving the model (12) – (16) minimizing the total deviation between the real disutility values and their approximations. The elements of the disutility matrix $\{d_{ij}\}$ form a finite set of values $d_0 < d_1 < \ldots < d_m$ where $D_0 = d_0$ and $D_{v+1} = d_m$. If there are only v different values between d_0 and d_m, we can determine the dividing points D_1, D_2 … D_v so that they are equal to these values. Then we obtain the exact solution by solving the problem (1) - (5). Otherwise, the user´s disutility can be only estimated knowing that it

belongs to the interval (D_s, D_{s+1}] given by a pair of dividing points. If we were able to anticipate the frequency n_h of each d_h in the optimal solution, we could minimize the deviation using dividing points obtained by solving the following model.

$$\textit{Minimize} \qquad \sum_{t=1}^{m}\sum_{h=1}^{t}(d_t - d_h)n_h z_{ht} \tag{12}$$

$$\textit{Subject to:} \quad z_{(h-1)t} \le z_{ht} \quad \textit{for } t = 2,...,m \textit{ and } h = 2,...,t \tag{13}$$

$$\sum_{t=h}^{m} z_{ht} = 1 \quad \textit{for } h = 1, 2, \ldots, m \tag{14}$$

$$\sum_{t=1}^{m-1} z_{tt} = v \tag{15}$$

$$z_{ht} \ge 0 \quad \textit{for } t = 1,...,m \textit{ and } h = 1,...,t \tag{16}$$

The decision variable z_{ht} takes the value of 1 if the disutility d_h belongs to the interval which ends by the dividing point d_t. The link-up constraints (13) ensure that the disutility d_{h-1} can belong to the interval ending with d_t only if each disutility between d_{h-1} and d_t belongs to this interval. Constraint (14) assures that each disutility d_h belongs to some interval and constraint (15) enables only v dividing points to be chosen. After the problem (12) - (16) is solved, the nonzero values of z_{tt} indicate the disutility values d_t which correspond with the optimal dividing points. The constant n_h represents the relevance of the disutility value d_h, which means the expected frequency of this disutility value in the unknown optimal solution studied in [7], [8]. Based on our previous research aimed at proper estimation of n_h, the most suitable proved to be the expression (17), where the value of N_h represents the frequency of d_h in the matrix $\{d_{ij}\}$.

$$n_h = N_h g(h) \quad \textit{for } h = 0, 1, \ldots, m \tag{17}$$

The function $g(h)$ used in the expression (17) is equal to 1 for each $h \le h_{crit}$ and it is defined by the formula (18) for $h > h_{crit}$.

$$g(h) = e^{-\frac{h-h_{crit}}{T}} \tag{18}$$

The constants T and h_{crit} are parameters of the approach. T is the shaping parameter and h_{crit} is the critical value, which can be determined according to (19). Based on our previous experiments described in [1], the most appropriate setting of T is the value of 1. Therefore we used this value also in all the numerical experiments reported in this paper.

$$h_{crit} = min\left\{ h \in Z^+ : \sum_{u=0}^{h} N_u \ge \frac{\sqrt{|I|/p}}{p} \sum_{t=0}^{m} N_t \right\} \tag{19}$$

5. Computational Study

Presented modelling strategies to emergency system design defined on the radial formulation of the weighted *p*-median problem have been studied from many points of view. The basic comparison was performed on computational times. Furthermore, the resulting system designs were compared. To evaluate the difference between two vectors of location variables y_i, the *Hamming distance* was used. If we have two vectors $Y^a = (y^a_1, y^a_2 \ldots y^a_n)$ and $Y^b = (y^b_1, y^b_2 \ldots y^b_n)$ of the same cardinality n, then the *Hamming distance* can be computed according to (20).

$$HD(Y^a, Y^b) = \sum_{i=1}^{n} \left(y_i^a - y_i^b \right)^2 \tag{20}$$

In all performed experiments, the result of the model (1) – (5) was taken as a referential design, to which the other designs obtained by the model (7) – (11) were compared. The comparison of the system designs only by the location vectors is not suitable as it can lead to misleading conclusions. It is theoretically possible to get very different location patterns that are much closed when it comes to the objective function value [3]. Therefore, we have suggested also another comparison.

For each system design given by the values of variables y_i, the objective function $ObjF_r$ was computed by (21). In this expression, the value r was set to 1 and 2, even though the models were solved for different values. If the objective function values were not computed in the same way for each system design, the results would not be mutually comparable.

$$ObjF_r = \sum_{j \in J} \sum_{k=1}^{r} \phi_k (d_{ij} : i \in I, y_i = 1) \tag{21}$$

All experiments were performed using the optimization software FICO Xpress 7.7 (64-bit, release 2014). The associated code was run on a PC equipped with the Intel® Core™ i7 2630 QM processor with the parameters: 2.0 GHz and 8 GB RAM. The approaches were tested on the pool of benchmarks obtained from the road network of Slovak Republic. The instances are organized so that they correspond to the administrative organization of Slovakia. For each self-governing region (Bratislava - BA, Banská Bystrica - BB, Košice - KE, Nitra - NR, Prešov - PO, Trenčín - TN, Trnava - TT and Žilina - ZA) all cities and villages with corresponding number of inhabitants b_j were taken. The coefficients b_j are rounded to hundreds. The number of possible service center locations $|I|$ is the same as the number of user locations $|J|$ in all solved instances and the network distance from a user location to the nearest located center was taken as a user´s disutility.

The obtained results are reported in the Table 1. The computational time in seconds is given in columns denoted by *CT*. The value of the parameter T used in the expression (18) was set to 1. The number v of dividing points was set to the value of 20.

Region	$\|I\|$	p	***Model (1) – (5)***			***Model (7) – (11) $r = 2$***				***Model (7) – (11) $r = 3$***			
			CT	***$ObjF_1$***	***$ObjF_2$***	***CT***	***$ObjF_1$***	***$ObjF_2$***	***HD***	***CT***	***$ObjF_1$***	***$ObjF_2$***	***HD***
BA	87	9	0.23	20743	79151	0.26	26952	73654	4	0.25	33337	81080	8
BB	515	52	1.63	17293	98169	1.65	23004	73681	48	1.82	28425	82462	62
KE	460	46	1.85	20242	91216	2.68	26191	75828	34	1.97	31788	86726	46
NR	350	35	1.29	22651	110878	1.3	27813	89827	30	1.2	31160	97784	40
PO	664	67	2.66	20025	94934	2.78	25234	81410	60	2.77	28991	88463	70
TN	276	28	0.91	15863	77799	0.97	19985	63223	24	0.88	21907	66802	30
TT	249	25	0.99	18873	91544	1.05	25195	69992	24	0.98	29438	82015	28
ZA	315	32	1.11	21018	102487	1.08	27189	81360	30	1.11	32507	92124	34

Tab. 1. Results of numerical experiments

The results of numerical experiments show that the two compared modelling strategies differ a lot. The model concerning more than one service providing center for each user brings a totally different solution as concerns the values of location variables y_i. On the other hand, this information tells nothing about the design as concerns total user discomfort. Comparing the objective function values $ObjF_1$ for $r = 1$ and $ObjF_2$ for $r = 2$ computed for each system design, we can observe, that the resulting solutions significantly differ not only in the service center locations, but also in the objective functions values. Thus we can conclude, that the simplification with only one service center for each user does not hold for emergency service system designing due to stochastic features of real system, which should be considered in the way of system modelling. As far as computational time is concerned, the approaches are very similar. Radial formulation of the weighted p-median problem constitutes a promising approach to large-scaled problem instances, which have been resisted to recent attempts to their solving.

6. Conclusion

The main goal of this study was to present and compare two different modelling strategies to design an emergency service system using the weighted *p*-median problem. The first strategy follows the idea that only one nearest located service center can be taken as a source of individual user´s disutility. In the second one more centers are considered. Both approaches are based on a radial formulation of the problem, which was developed for effective solving of large instances. The performed numerical experiments show that the number of service providing centers for each user significantly impacts the resulting system design and therefore it is necessary to choose an appropriate modelling technique, which would model the real system as precisely as possible.

Finally, it would be relevant and interesting to compare the performance characteristics of the system proposed by different models using simulation experiments. This will be a topic of our future research in this field.

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METHODOLOGY FOR ASSESSING THE QUALITY OF RAIL CONNECTIONS ON THE NETWORK

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Abstract. The role of the EU transport system is to provide a high degree of mobility where necessary, to increase its performance in terms of speed, comfort, and safety. Achieving a consistent, integrated, and efficient transport system currently requires connections linking all transport modes. The most important criteria from the point of view of passengers are the reachability of the destination and frequency. This paper assesses the quality of rail services by considering the supply of connections on the network. It proposes a methodology for evaluating the constructed timetable in passenger traffic for the assessment of the achievability of tariff points. We also present some results of a case study of a Slovakian railway network.

Keywords: relation, transfers, speed, quality, network.

1. Introduction

The EU pays systematic attention to the quality of passenger transport [1]. Quality is perceived differently by users and transportation service providers or organizers of transport as well as by society. The needs and expectations of customers are met by establishing procedures under the provisions of the Regulation of the European Parliament and Council Regulation (EC) No. 1371/2007 on rail passengers' rights and obligations [3].

The cornerstone of transport services is to provide travel opportunities by creating links and connections. Often, after the introduction of the new timetable under discussion whether it is better or worse, each approach is evaluated in a subjective manner. The authors solved some partially problematic of rail passenger quality services [4]. At present, there is no methodology for assessing train timetables from the transportation point of view as a whole. We evaluate specific trains and connections in the stations only, but not the quality of the connection from point A to point B.

The aim of this paper is to introduce a new methodology for the assessment of timetables in terms of passenger traffic focused on connectivity and linking. From the passenger's point of view, it is necessary to assess the availability of travelling opportunities between selected points on the rail network. The travel offer from A to B is in principle affected by travel time, number of transfers (changing the transport means), and number of travel opportunities. Connectivity and linking also affect several factors. This is an outcome for setting of draft criteria for connection evaluation [7] and [8].

Introduced study is designed in purview of the set up a tool for an objective evaluation of the quality of public transport service. Specifically, the aspects of availability and time of the transport services in selected geographical area are closed to the Standard EN 13816 [2].

2. Selecting a set of tariff points for evaluation

The aim of the proposed methodology is the comprehensive evaluation of the whole timetable in terms of train passenger services. An ideal case is to evaluate all existing relations between all tariff

points for passenger transport on the railway network. If the rail network contains *n* tariff points for passenger transportation, then the number of sessions to be examined is *m*:

$$m = n * (n - 1) \quad (1)$$

For the assessment of connection quality between stations and stops, it is necessary to select a set of representative tariff points which ensures quality assessment on a network-wide scale. For the selection of stations and stops for this sample, it is appropriate to identify specific process steps. Following the individual steps of the proposed procedure, we select tariff points according to the following evaluation criteria:

- Demographic and geographic criteria (population criterion, meaning places of importance in public administration and local government),
- Criterion of railway geography (location and importance of stations on the rail network - crossroads, junction stations),
- Criterion of tourist destinations (the inclusion of stations with significant potential inflows of passengers).

3. Proposed procedure of connection assessment

The proposed methodology aims to comprehensively cover the possibility of achieving any pair of tariff points by passenger trains on a selected rail network in order to assess the quality of the travel opportunities in this area by using selected indicators [5].

The methodology is based on the evaluation of defined criteria for connectivity between the selected tariff points on the network. Based on the methodology, we evaluate a particular connection. It is necessary to determine whether the connection is evaluated during the working day or at the weekend. It is also possible to evaluate on a selected working day, Saturday, or Sunday. Consequently, we evaluate the summarizing indicators for services in terms of particular relations within the examined networks [7].

3.1. Connection evaluation

For assessing the connectivity and quality of connections in an examined relation (session), we identify the following factors, some of them are introduced in literature [6]:

- *Number of connections* N_s during the reporting day, direct connections as well connections with changing (transfers).
- *Average waiting time of passenger* W_i. This is the time that the passenger has to wait for connection to a point of departure, possibly a transfer point. It is defined as half of the time between the departure of two successive connections:

$$W_i = \frac{(t_{i+1} - t_i)}{2} \; [h] \quad (2)$$

where:

t_i departure time of train at the boarding station for a rated connection
t_{i+1} departure time of the next train at the boarding station of the next connection

- *Distance route of relation* L_i. This is the travel distance by vehicles creating the connection. This criterion is important to calculate transportation speed and the rate of achievement.
- *Type and number of trains* creating the connection. This factor reflects the quality of transport services on the connection. In terms of ZSR, the types of trains are EC - EuroCity, IC - InterCity, Ex - Express trains, R - fast trains, Zr - semi fast trains, and Os - passenger trains.

- *Transportation time* T_p. Time between the departure from the boarding station on the route and disembarking the train at the destination railway station (tariff point).
- *Number of transfers* (changing transport means) N_p. This is the absolute number of changes of transport vehicles (trains) before reaching the target station.
- *Transfer time* T_w. This is the total time that passengers spend waiting for connections at the transfer station (by changing transport means) when using a particular connection:

$$T_w = \sum\left(t_{i2dep} - t_{i1arr}\right) [min] \quad (3)$$

where:
t_{i2dep} is the departure time of the connecting train at the transfer station during *i* changing
t_{i1arr} is the arrival time of the train to the transfer station during i changing

- *Achieving time* T_D. This is the time from embarking when the travel trip begins, to the arrival of the train at the destination railway station. It is calculated as the sum of the average waiting time and transportation time:

$$T_D = W_i + T_P [h] \quad (4)$$

- *Transportation speed* V_P. This is given as a proportion of the distance travelled and time of transfer:

$$V_P = \frac{L_i}{T_P} \quad [km.h^{-1}] \quad (5)$$

where:

L_i distance route of relation [km]
T_P transportation time [h]

- *Achieving start-stop speed* V_D. This is given as a proportion of the length of the relation and achieving time:

$$V_D = \frac{L_i}{T_D} [km.h^{-1}] \quad (6)$$

Transportation speed and achieving speed are important evaluation criteria for the quality of a particular connection relation. They are convenient indicators for comparing public transport link connections with individual transport [7] and [8].

3.2. Relation evaluation

After processing connections within single relations, it is necessary to evaluate the relation between tariff points on the network. For each relation, average values are calculated for all connections: number of transfers, transfer time, transportation speed, and achieving speed. It is also appropriate to verbally assess and justify the results of the calculations. The sample of evaluation of relation is introduced in Table 1.

Connection Nr. -	*Station Bratislava hl.st.* *dep.* [hh:min]	*Station Rimavska Sobota* *arr.* [hh:min]	*Average waiting time* W_i [h]	*Connect. distance* L_i [km]	*Transport means*	*Transport time* T_p [h]	*Number of transfers* N_p	*Total changing time* T_w [min]	*Start-stop achieving time* T_D [h]	*Travel speed* V_P [km.h^{-1}]	*Start-stop achieving speed* V_D [km.h^{-1}]
1	6:01	11:58	7.00	318	R,Os,Os	5,95	2	27	12.95	53.45	24.56
2	8:01	12:58	1.00	318	R,Os	4,95	1	5	5.95	64.24	53.45
3	10:01	15:58	1.00	318	R, Os,Os	5,95	2	27	6.95	53.45	45.76
4	12:01	16:58	1.00	318	R,Os	4,95	1	5	5.95	64.24	53.45
5	14:01	19:54	1.00	318	R,Os,Os	5,88	2	27	6.88	54.05	46.20
6	16:01	20:58	1.00	318	R,Os	4,95	1	5	5.95	64.24	53.45
7	23:49	5:20	3.90	318	R,Os	5,35	1	19	9.25	59.63	34.38
Average per connection:							**1.43**	**16.43**	**7.70**	**59.02**	**44.46**

Tab. 1. Sample of connection assessment on the Bratislava – Rimavska Sobota relation (Friday)

4. Case Study

The research team elaborates on the case study to verify the proposed methodology. It was applied on connections on the railway network of Slovak Railways (ZSR). We selected relations from the Bratislava main station to selected tariff points on the ZSR network (see Fig. 1). According to the proposed methodology and selection criteria, we identified 59 tariff points on the ZSR network. For the representative set of stations and stops, we selected first county centres, district towns over 20,000 inhabitants, junctions, and railway stations according to the criteria of geography and subsequently tourism centres so that each of the track lines in a set has at least one tariff point. The selected day of the week for the examination was Friday.

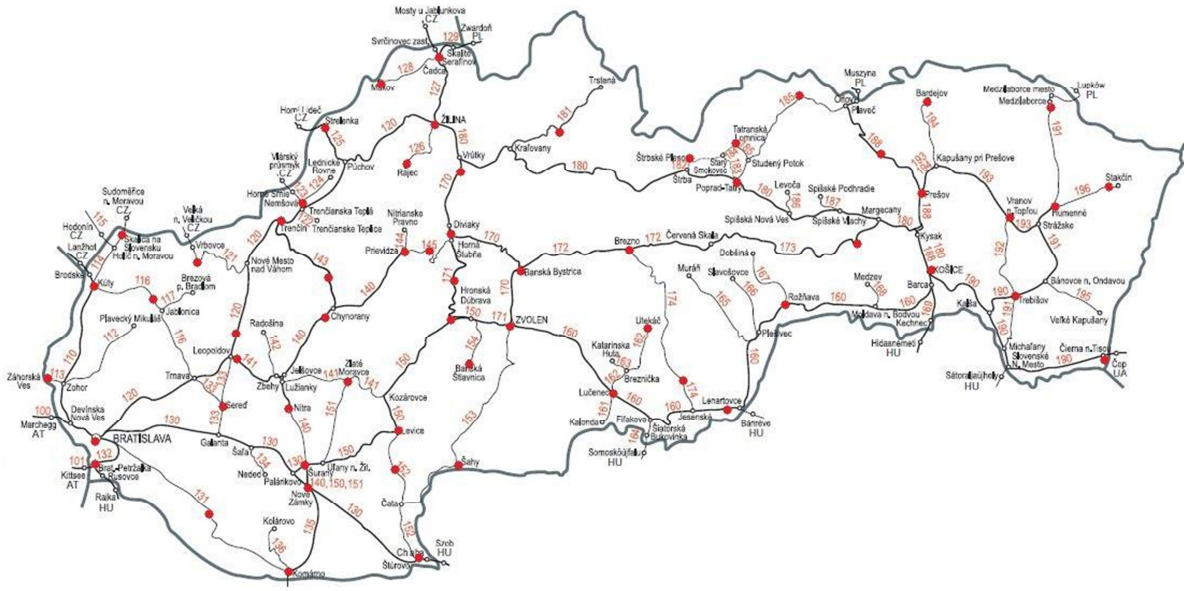

Fig. 1. Network map of ZSR showing the selected tariff points for assessing the quality of rail connections

In the timetable for 2015 and under the proposed methodology, we retrieved for each relation all connections. For each connection, we set the value factors of the number of connections during the reporting day, the average waiting time W_i of passengers, the distance route of relation L_i, transportation time T_{pi}, number of transfers, transfer time T_{wi}, achieving time T_{Di}, transportation speed V_{Pi}, and achieving speed V_D.

Subsequently, we evaluated the relations. The most important evaluation criteria for the relations are listed in Table 2 that shows excerption of the start-stop achieving speed, average waiting time per relation, and average travel speed per relation. The listed factors characterises the

transport service and are provided as outcome of an objective analyse of the offered connections according to the time table.

From Bratislava to destination	*Average travel speed per relation* V_P [km.h^{-1}]	*From Bratislava to destination*	*Start-stop achieving speed* V_D [km.h^{-1}]	*From Bratislava to destination*	*Average transfer time* T_w [min]
Kuty	92.07	Turcianske Teplice	67.17	Dunajska Streda	0.00
Sturovo	91.06	Trencin	65.21	Poprad	0.00
Piestany	88.73	Kuty	61.47	Sturovo	0.00
Trencin	84.18	Poprad	60.01	Trencin	0.21
Nemsova	82.89	Nove Zamky	57.03	Levice	0.25
Martin	78.38	Sturovo	56.66	Kosice	0.63
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Kremnica	44.09	Vranov n. Toplou	29.77	Bardejov	33.29
Handlova	40.96	Bardejov	27.80	Humene	33.57
Utekac	39.34	Stara Lubovna	26.03	Vranov n. Toplou	40.00
Vranov n. Toplou	39.13	Makov	25.55	Zlate Moravce	40.00
Makov	36.87	Zahorska Ves	25.33	Makov	40.43
Bardejov	36.56	Zlate Moravce	18.56	Kremnica	46.60
Average per relation	**60.21**	**Average per relation**	**43.22**	**Average per relation**	**17.35**

Tab. 2. Results of the evaluation of connections on relations from the Bratislava main station according to average transportation speed, start-stop achieving speed, and average number of transfers (changing)

On the ZSR network, the highest average speed on modernized track lines from Bratislava to Trencin were direct connections. The start-stop speed was the highest on direct relations too, namely from Bratislava to Turcianske Teplice, Trencin, Kuty, and Poprad. Just as quick are connections to Makov, Zahorska Ves, and Zlate Moravce, indicating a slow connection in combination with long waiting times because of the small number of connections. The rate of average transfer time confirms this fact. The longest average waiting times is in the relations Bratislava–Kremnica, Bratislava–Makov, and Bratislava–Zlate Moravce.

5. Conclusion

The issue of connectivity evaluation has not yet been sufficiently elaborated in the literature and is not used in practice where the connections from one station only are rated. This paper introduced the idea of a new evaluation methodology and included a case study on the network connection from the Bratislava main station to defined tariff points.

The proposed methodology covers the possibility of achieving any pair of tariff points in a selected railway network comprehensively. It not only offers an evaluation of the connectivity on a particular relation, but also objectively assesses the availability of connections between two selected tariff points based on quality indicators such as average number of transfers, average waiting time, average transportation speed, and average achieving speed. This enables us to evaluate the quality of the travel opportunities in this area by using selected indicators. Subsequently, using MCA allows us to evaluate the degree of customer satisfaction with selected quality attributes based on their importance. Ultimately, it is possible to examine the statistical dependence of the number of transported rail passengers by examining the quality connection on the network.

This methodology synthesizes knowledge from the theory of passenger transport and provides an evaluation of the connectivity and quality of constructed timetables for the entire rail network or only on selected rail networks.

It should be noted that the character of the current rail network loses due to gradual liberalization. Therefore, the significance of this methodology in the future will increase. The proposed methodology will be helpful for ministries of transport, regional public transport

authorities, and other transport ordering bodies as well for integrated transport coordinators. The most important benefit of the proposal is that the evaluation is carried out in terms of the interests of passengers as users of a transport system that requires direct and fast connections. The resulting methodology can be applied in subsequent layouts of transport networks for public transport.

The proposal will contribute to the creation of a competitive transport system that efficiently uses system resources. That is the plan of a Single European Transport Area within the purview of the White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system". This aims at the realization of an efficient and integrated system of mobility. The importance of the quality, accessibility, and reliability of transport services in the coming years may be even more important.

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New Trends in Passive Safety of Vehicle

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Abstract. The article is focused on the exploration and analysis of passive safety as part of the construction and operation of road vehicles. Pressure on the development of new technologies is very high. Many consumers when purchasing a vehicle just considering the degree of vehicle safety. It is associated with increased degree of motorization and the increasing number of fatalities wishing to avoid vehicle users.

Keywords: passive safety of vehicle, crash-test, new trends of safety

1. Introduction

It can prevent equipment failure driver, or it is technologically limited injuries vehicle occupants in an accident? This is a very important question that must be taken into account prie vehicle designs manufacturers. Vehicle safety is one of the most important issues addressed by the customer when buying a vehicle. Cars are equipped with various technological security elements, which in the case of an accident can save lives. For safe driving are not only important technical solutions and equipment of cars. Compliance with security regulations of speed but also appropriate behavior on the roads significantly affect the amount of road accidents. Also play a great role capability of the driver. Some overestimate their powers and abilities, as well as the possibility of his car.

Development is subject to market demand for new technologies introduced into the vehicle from the high density of traffic and the lack of infrastructure, which can not actually handle such a burden. If you experience this problem, please add and stress during rush hour, it is more than likely a traffic accident. I therefore drivers who use their vehicle proactive approach to the safety of the car very strongly. Yet no one wants to buy a car to him in critical situations not protect against injury or death. The same applies to the security of the whole crew. Many systems are built directly from the vehicle registration, many you need to buy a car, and some also needs to be purchased outside the vehicle distribution (eg. Child seats.)

The main purpose of this work is to issue the operation and use of technical means, which are applied in road transport in order to increase the safety of the crew vehicles. In the second part of the work is devoted to study the possibility of performing tests of vehicles, as well as the safety analysis of four specific vehicles that such brands are among the most popular among users.

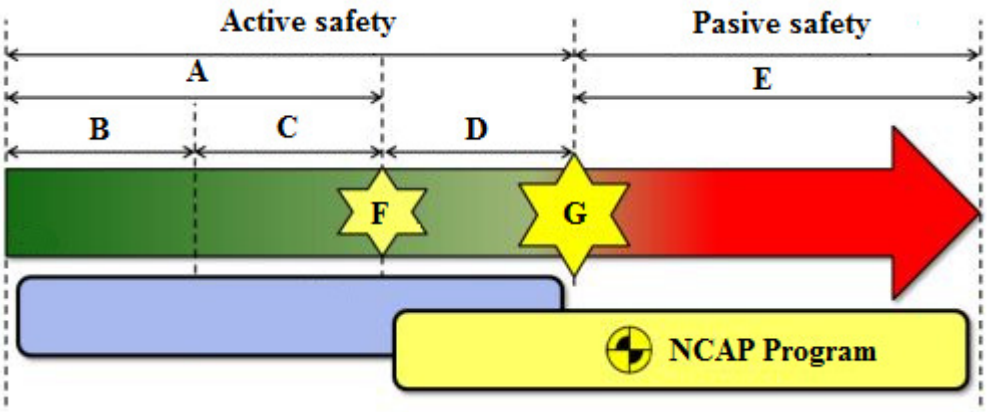
1.1. Safety systems of road traffic

It is now possible to observe a high degree of advancement of technology solutions in cars and trucks. Each of the automakers trying to gain a strong position in the market. Due to the density of the road network and the accident is definitely a strong indicator and safety of each vehicle. It is a combination of technological features, the cost and performance of individual vehicles. Some automakers have convoluted security systems, but in normal conditions have a major effect. This is especially the lower economic class cars that are made with cheap imitations of the security systems of higher class vehicles. These systems should be effective only to a limited extent. In general, we

can divide the safety systems in the vehicle in two categories: active and passive safety car. Active safety car includes those technological solutions that are designed to protect and promote uncollision car handling. Passive safety of road transport is a concept that consists of a set of design and technological solutions that are designed and mitigate the consequences of a collision.

1.2. Passive safety of road vehicle

This is a practical application of design, construction, equipment and regulation technologies in order to minimize loss of life and injury in an accident. These security systems protect not only vehicle occupants but also pedestrians who are road users. This form of technology is called passive, precisely because of its efficiency occurs at the moment of the accident (ie during normal operation of the car is a passive activity). For this sector is characterized by innovation and rigorous testing functionality. New car it is possible to observe a close connection between elements of active, passive safety and telematics technologies.



Obr.1: Views the efficiency of active and passive safety

Explanations for this picture:
A - prevention of hazards
B - detection of potential hazard
C - avoidance of accidents
D - hazard mitigation
E - alleviating the consequences of an accident
F - moment undiversion accident
G - moment of accident

Individual actions and situations are expressed in the timeline. For designing and testing technology is important consider each of the occurrence and consequences of an accident. In the event of a traffic accident occurs putting into passive safety. The kinetic energy of the vehicle shall be in an accident absorbed so that passengers in the least danger. Therefore, the vehicle body extends over the three parts. A passenger is placed in the middle, and is defined as a safety cell of the entire car. Front and rear are placed so. soft crumple zones. The safety body structure is achieved by a special structure, the critical points of the body, is the use of rigid and strong longitudinal and transverse beams and are reinforced, and the pillars to obtain the best possible protection. When an impact is then deformed body and absorbs much of the energy to keep the passenger compartment without significant changes.

The basic passive safety systems of cars include:

- airbags
- belt tensioners / seat belts,

- active seats and head restraints,
- crumple zones,
- laminated glass and polycarbonate.

1.2.1. Airbags and construction

Airbag is a bag of lightweight and breathable material, which in the event of an accident inflated before passengers or next to him and called shock his body. It might be argued that at present it is standard equipment on new cars. Bag is made of thin fabric mounted in the steering wheel, instrument panel, seats, doors and the like. Such a design is designed such that when the module are activated, wherein the temperature is in the range of 150-200 ° C, did not cause the explosion of the element.

Brains airbag control, the control unit ACU (original airbag control unit). The design of this unit is a simple design. This is the type of control unit, which by the acceleration sensor, lateral pressure sensors, brake pressure sensor stocking seats, wheel speed sensors and gyros. The signals of these units are sent to the unit, which one then determines the angle of incidence, severity, and the power accident. Depending on the outcome of these calculations and air bag unit can activate various additional restraints such as seat belts or other types of airbags. Each detained system is usually activated with one or more pyrotechnic devices.

In the past, leading to unnecessary activation of airbags. Therefore, today, in vehicles fitted complicated triggering algorithms are much more complex. These kinds of algorithms can take into account such factors as the weight of a passenger seat is occupied, the use of seat belts, and even evaluate whether the seat fitting child seats.

Among the most popular manufacturers of airbags include: AUTOLIV, Siemens, TRW, Bosch, TEMIC, NALDEC and VDO.

In terms of construction and design can be divided as follows airbags. :

- front airbags,
- side airbags,
- knee airbag,
- rear-mounted airbags.

New trends in the construction of airbags

External airbags - this is a new trend in the construction and use of airbags, which began using automaker Volvo in their vehicles. The performances took place at the Geneva Motor Show (2012) to protect pedestrians in a collision. The system uses a sensor that detects pedestrians in the path of the car and when it detects that a collision is inevitable, it activates the external airbag and tilt the hood to lessen its impact.

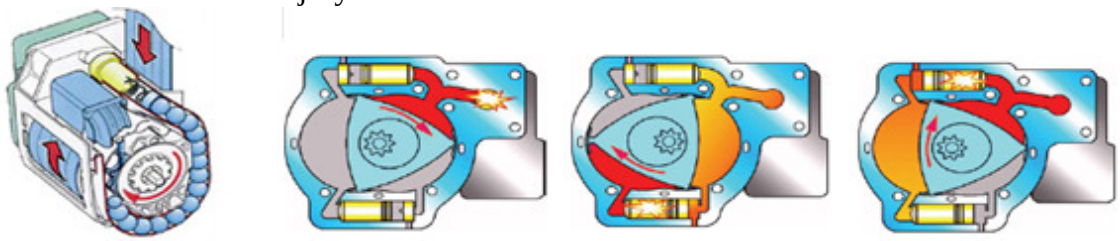
Motorcycle airbag - due to the increasing amount of traffic accidents motorcyclists, the designers try and protect these road users. It motorcyclists are very vulnerable during an accident, because at high speed can replace them in another vehicle, wall or pavement. For this reason, many manufacturers produce so. airbag suit, which was developed in order to protect riders Grand Prix. However, very successfully extended the normal riders on motorbikes. The airbag is not part of the vehicle, but it is a suit that is connected to a cable of a motorcycle and for disconnection activation occurs in the belt part, for better protection of the spine, motorcycle on impact.

1.2.2. Belt tensioners and seat belts

Seat respectively. Seat belts are the most the most common, easiest and least expensive component of passive vehicle safety and at the same time is among the most effective element of vehicle safety. The automotive industry is the most commonly installed a traditional three-point seat

belt. In the automotive industry are also used 4 or 6 point safety harness, which shall apply in the racing sector. The primary role of the safety belt was of a very simple form. You should avoid the force of inertia may fall through the passenger windshield or bump on the dashboard of the vehicle. This task this satisfies today. In normal structures bands find itself strap attached to a winding mechanism using spiral strings applied rotational force, which in turn pulls the belt to the body.

We know the mechanical switches and pyrotechnic belt tensioners. Mechanical tensioner Otherwise the inertia impact. Mechanical prestressing seatbelt is activated in a frontal or near-frontal collision at a speed exceeding 12 km / h. The belt must passengers in an accident as soon as possible to capture and firmly pull. Due to certain kinds of clothes (Material used) there is full functionality retractors device. This effect is called a loose belt. Belt tensioners that are activated by pyrotechnic, offset loose belts so that on impact the belt tightened. Tensioners are activated gas generator through the airbag control unit. In this case the belt tensioners have a lower threshold for its activation, as the front airbags. This means in practice that is also activated in the accident, which still requires the intervention of the airbag. When released, the seat belt pretensioner tightens. Due to the fact that the seat belt adheres tightly to the body, passengers are exposed to a strong deceleration of the vehicle and body burden is evenly distributed throughout the process captured body => decreases the risk of injury.



Obr.2: Diagram of the operation of the pyrotechnic seatbelt pretensioners

1.2.3. Active seats and head restraints

The impact is as dangerous and body movement to return to the seat. Kickback body with a sharp head tilt backwards. It was therefore developed further additional system security, active front seats. Already during a crash into obstacles to fold down the backrest backwards, reducing the load on the spine mainly passenger. Another forward movement is then captured by safety belts steering wheel and knee airbag.

Active Protection System heads are built into the front seat and in the event of impact moves head restraints slightly forward. Thanks to the heads of passengers and more efficiently capture and reduce the risk of more serious the advice.

2. Testing of passive safety system

New vehicles marketed undergoing various tests, tests of passive safety including. Hoc these tests are not currently required, nearly all car manufacturers these tests are conducted. Both in terms of security and a good name in the market and in terms of the presentation of the vehicle itself and support its sales. The most common and best known test crash tests are designed primarily specialists in order to accurately simulate certain types of real impact. These shocks are simulated on the basis of long-standing investigation of accident records.

The methodology of examining the effectiveness of passive safety:

1. Preparation for the test - Preparation of test cars, mannequins, cameras, measuring devices, then calculations, measurements and preparation other accessories
2. Implementation of the crash test
3. Analysis of the measurement and recording of information and its subsequent evaluation.

2.1. Criteria for evaluation

The overall result of these tests is expressed by the number of stars, with 5 stars is the best in safety, which gradually decreases with shrinking star. With the development of the requirements placed on the market in the automotive industry are increasing and evaluation criteria. The public car even spread rumors also buying "stars". It's understandable, because this is the best advertisement for the vehicle. As mentioned above, the stars are awarded on the basis of tests in four test groups. To obtain individual stars shall require a minimum assessment in the following table:

	5* rating	4* rating	3* rating
The overall average	80 %	70 %	60 %
Adult occupant protection	80 %	70 %	40 %
Protecting children	75 %	60 %	30 %
Pedestrian protection	60 %	50 %	25 %
Assistance systems	60%	40 %	25 %

Tab. 1. Minimum criteria for obtaining assessment Euro NCAP

3. Conclusion

The article analyzed the basic elements of passive safety in vehicles and their impact on the vehicle occupants during an accident. Each of these elements has to some extent reduce the risk of injury or loss of life, any subscriber accident. Of course, different technical embodiments as well as their efficiency may vary depending on the manufacturer and also the class of the vehicle in which the system is mounted. Generally, many say that the higher class vehicles are equipped with better technical features and therefore should be even safer. Modern design trends are bringing the active safety features in vehicles and lower classes, for which similar things are not specific. However, the safety of the individual vehicles of the same category may vary significantly. It can not be clearly determined that the vehicle is so. safest. Each vehicle is specific to different transferring element of the safety and hence the protection of individual categories of participants. If the vehicle offers a high level of protection for adult passengers in the front seat, it's usually at the expense of foot passengers. Almost all vehicles produced today have the biggest problem with just this category. The most critical vehicles for pedestrians are SUVs, which in turn are in most cases highly specific protection of adult occupants of the front seats. Thus, the huge structure in this case their main advantages and "Achilles' heel". Designers are therefore seeking to combine all four categories of security so that they can protect all road users, as far as possible.

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Auditory warning signals effectiveness

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Abstract.
This paper describes troubles with localization of emergency vehicles. The warning siren is the only non-visible device alerting motorists of an approaching emergency vehicle. An auditory warning signal, before being heard by a motorist, must go through several barriers, which attenuate it. In order to define effectiveness of auditory warning signals, noise reduction of a typical passenger vehicle was measured and compared with most common used sirens. Also attempts to improving the auditory signals, by adding new siren tones, are described. In the last section, advantages and disadvantages of the vehicular communication systems are discussed.

Keywords: auditory warning signals, siren, vehicular communication system.

1. Introduction

Every driver someday experienced such a situation: you hear a siren of an emergency vehicle and after a long period of time you are able to localize the sound source. Moreover, there are situations that motorists suddenly notice an emergency vehicle on a road, but still cannot hear it. That happens because they are occupied by driving and are not expecting to hear a siren. That happens because the sound pressure level inside the car is not high enough to draw attention of motorist [1,2].

An auditory warning signal from an emergency vehicle must reach and inform road users early enough to give them time for reaction. Drivers should be able to quick localize source of a signal and react in proper way. Unfortunately sometimes the “wake-effect” occurs. It is when drivers localizes emergency vehicle too late and try to give way as quick as possible, raising the risk of an accident [3].

The key issue is the audibility of the warning siren of emergency vehicles. However, simply increasing the loudness of the sirens is inappropriate, because most of them are operating at maximum permitted levels, in terms of noise pollution in cities and noise induced hearing loss of emergency vehicle drivers [1].

2. Passenger vehicle noise reduction

Noise reduction of a passenger vehicle is a function of manufacturers efforts to reduce the interior noise, the vehicle structure, its interior, windows and seals. An experiment was conducted to measure the average noise reduction of a typical passenger vehicle. The vehicle tested was a 2001 Renault Clio. The measurements took place in open area, far from reflecting surfaces and with low background noise. Three loudspeakers were situated at a distance of 5m at front, left side and rear of a vehicle, in order to measure the vehicle noise reduction for sounds coming from different sides and thus by different barriers. The doors and windows were closed for the tests. The experiment was conducted by placing a microphone inside the vehicle at the driver’s head position and in the same place but without vehicle. The loudspeakers emitted pink noise to ensure broad

frequency range [4]. The noise reduction (NR) is the difference between the sound pressure level outside and inside the vehicle:

$$NR = L_{Po} - L_{Pi} \quad (1)$$

L_{Po} – SPL outside the vehicle
L_{Pi} – SPL inside the vehicle

Figure 1. shows the average noise reduction values for a passenger vehicle in 1/3 octave bands from 100 Hz to 10 kHz.

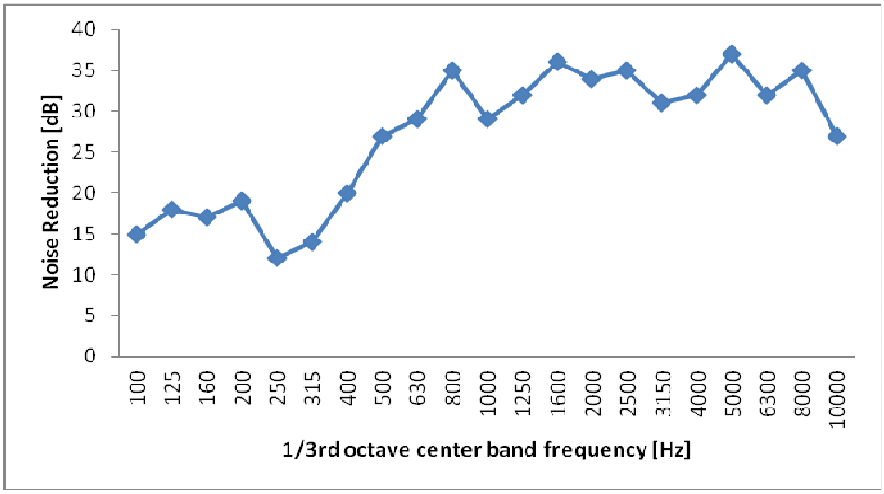

Fig. 1. Average noise reduction values for a passenger vehicle in 1/3 octave bands from 100 Hz to 10 kHz.

The results shows that tested passenger vehicle has a poor noise reduction at low frequencies and high attenuation at high frequencies. Also three deeps can be seen, around 300, 1000 and 4000 Hz, which corresponds with work of A. Balastegui, J. Romeu, A. Clot and S.R. Martin.

Analyzing these characteristic it can be concluded that sirens should emit low frequencies, up to 500 Hz. However, low frequencies alone do not draw our attention and thus should be combined with high frequencies and have short repetition time [1,5]. The shorter the repetition of the sound source, the higher the perceived urgency [2]. Sirens also cannot be annoying, which affect especially citizens near the fire departments, hospitals and ambulance stations.

3. Improvement of auditory warning signals

In every European country there are different regulations of maximum and minimum sound pressure levels of emergency vehicle sirens. Additionally, different frequencies are used to discriminate the type of service. However, their average A-weighted sound pressure level is 121 dB [2]. In table 1, list of most common used siren tones are presented.

	Tone	Frequency [Hz]	Repetition [cycles/min]
1	Standard Wail	600-1200	12
2	Standard Yelp	600-1200	180
3	Standard Two-tones slow	450 and 600	33
4	Standard Two-tones fast	450 and 600	68

Tab.1.List of most common used siren tones [1].

Scientists from University of California conducted research on effectiveness of emergency vehicle siren. They defined four detectability criteria from C1 to C4, in order to grant detection,

which specifies number of tones and their loudness above the masked hearing threshold in different 1/3 octave bands. They found an possibility to improve detecability distances of emergency vehicles and proposed new tones for sirens. Considering only the car noise reduction, they achieved good results in improving the detectability distances. However, taking into account more restricted criteria, like increased interior background noise and population with higher hearing threshold, it appears that there are situations in which it is not possible to detect an emergency vehicle even from close distance.

Figure 2 presents hearing threshold as a function of age. We can see that we lose ability to hear high frequency sounds and thus our hearing threshold rises.

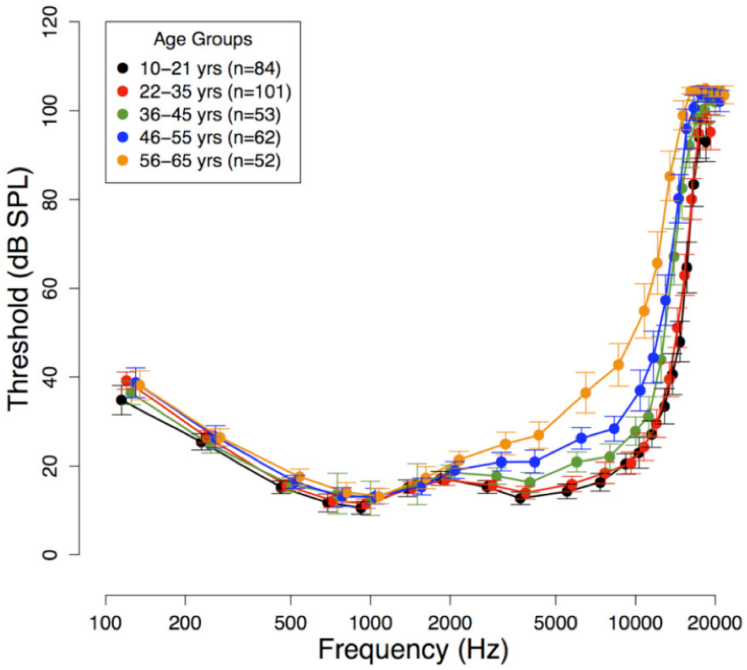

Fig. 2. Hearing threshold as a function of age [6].

4. Vehicular communication systems

Auditory warning signals are necessary not only to inform drivers but also other road users. However, in order to improve driving comfort, vehicles become more soundproof and thereby more isolated from the surroundings. So it worth to consider the vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication systems. Those systems enable a range of applications to enhance transportation safety and efficiency, as well as quick information. For example they can send warnings of road conditions, traffic congestion and also of an approaching emergency vehicles and give instructions how to react, e.g. creating a free corridor – the “blue wave”.

Main drawback of those systems is ensuring the security and privacy of data exchange, to prevent from illegitimately send of an warning message, e.g. to gain a driving advantage. An necessary condition for system to function properly is a large number of transmitter/receiver units. It involves construction of a network of stationary transmitter/receiver units along the road and concentrated near intersections and mounting additional devices in private vehicles. However, despite the enormous scope of work, V2V and V2I systems develop increasingly dynamic and in the coming years we can expect new usable prototype applications [7,8,9,10].

Conclusion

Analysis of auditory warning signals and conducted experiment suggests that those signals are ineffective, despite the attempts to improving them. The problem of masking the warning signal by

inner vehicle noise is still unsolved. But, perhaps it is impossible. Therefore, in order to be sure, that all road user will be warned of an approaching emergency vehicle, the vehicular communication systems should be put into action.

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Comments about the complaints of service quality realized by foodstuff transport company

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Abstract. In this paper range of services provided by one of the transport companies having their registered office in Szczecin have been characterized. The paper also presents the profile of the company. Methods of realization the customer's complaints are also described. A number of complaints reported during the company's activities and their character is showed. The following study describes the company strategy taken to reduce the number of lodged complaints by claimant.

Keywords: transportation, transport company, quality of service, complaints.

1. Introduction

Trucking is characterized by high availability, and thank s to its extensive dense network of road, goods may be delivered directly to the destination. During the implementation of the transport process, however, unforeseen problems may occur which may cause lodging a complaint to the transport company [1, 5].

Assessment of complaint of implementation the transport services quality is performed on exemplified Run-Trans company from Szczecin.

Run-Trans Company is a private company operating in national transport (Poland) and international since 1997. An initial profile of the company was mainly based on transport of aggregates. Then the company focused its activities on transport of food by specialized cisterns. Run-Trans company's offer includes the latest modern car kits consisting of a tractor of Man and Mercedes-Benz brand, as well as HOBUR cisterns, Feledbrnder and others. Liquids and granular and bulk materials can be transported using cisterns made of aluminum and stainless steel. The company is engaged in national and international transport, such as food products fruit juices, fruit puree, glucose, molasses, wine, milk, cream, fats, oils, glycerine, chocolate, cocoa butter, etc.

For monitoring the quality of provided services the company allows to lodge a complaint or claim about the quality of transport process. Complaint may be lodged within 7 days from the date of realization or the anticipated date of implementation of the transport service. Complaints shall be dealt within 14 working days of receive a correctly completed complaint form. Complaint should be submitted at the company's headquarters in person or via email.

2. Characteristics of complaints service

The most important features of lodging a complaint is the reason, and the detailed description of the situation. The reason for customer dissatisfaction and lodging a complaint may be: failure to perform services, delays in execution of the service, partial damage to goods, the total damage of goods, loss of goods, customer service quality [2, 3, 4].

In the described manufacturing company no transport quality system functions. The study confirmed that the company has developed its own system of receiving and processing customer complaints.

After recording, the claim is verified whether it is fully justified, and next the employees shall inform the client about decision: if the claim is justified, the company provides “compensation” to the client's proposal; if the complaint is not accepted, the customer receives the reasons for the decision.

Number of complaints from 1997 to 2014 is shown in Fig. 1.

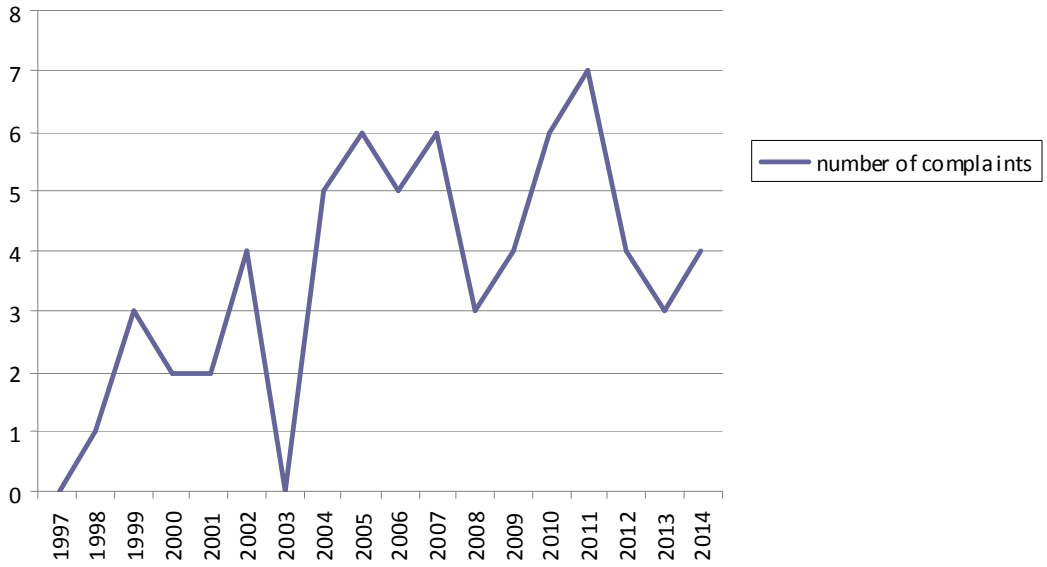

Fig. 1. Company Run–Trans - number of received complaints in the years 1997-2014.

During many years of the company's activities all recorded complaints were considered by the company, and claimant received compensation. In the nearly 17 years of business, the company recorded 67 complaints. This is a relatively large number, but in relation to the number of orders executed transports it is not too much. The average number of complaints per year is less than four complaints. The largest increase in the number of complaints was recorded in the years 2004-2007 and 2010-2011. The largest number of complaints was reported in 2011 - 7 complaints. In 1997 and 2003, the company has not recorded any of the complaints.

Tab. 1 shows the character of complaints in 2010-2014 and the company comments (reason of customer dissatisfaction) and the methods of compensation (solving the problem) by the transport company.

Tab. 1. Complaints made by company's customers in 2010–2014.

Date	Complaints	Comments	Solve the problem
2010	delay delivery	poor weather conditions	discount on another service
2010	delay delivery	poor weather conditions	discount on another service
2010	quality of customer service	incompetence of employee	discount on another service
2010	quality of customer service	impolite customer service	discount on another service
2010	delay delivery	poor weather conditions	discount on another service
2010	delay delivery	poor work organization	permanent discount
2011	goods damage	poor weather conditions	financial compensation
2011	delay delivery	poor weather conditions	permanent discount
2011	delay delivery	poor work organization	discount on another service
2011	quality of customer service	impolite customer service	discount on another service
2011	delay delivery	poor weather conditions	permanent discount

2011	quality of customer service	incompetence of employee	discount on another service
2011	quality of customer service	impolite customer service	discount on another service
2012	delay delivery	poor weather conditions	discount on another service
2012	delay delivery	poor weather conditions	permanent discount
2012	delay delivery	poor weather conditions	permanent discount
2012	quality of customer service	incompetence of employee	discount on another service
2013	delay delivery	poor weather conditions	discount on another service
2013	delay delivery	poor work organization	discount on another service
2013	quality of customer service	impolite customer service	discount on another service
2014	delay delivery	poor weather conditions	discount on another service
2014	delay delivery	poor weather conditions	permanent discount
2014	quality of customer service	impolite customer service	discount on another service
2014	delay delivery	poor weather conditions	discount on another service

Most complaints made by Run-Trans's customers in 2010-2014 was caused by delay in delivery (62.5% of complaints). Customers also have objections to the quality of customer service (33.3% of complaints). More than half (54.2%) of complaints was due to poor weather conditions, 20.8% - impolite customer service, and poor work organization concerned 12.5% of complaints. Similarly, as to the competence of employees - 12.5%. Over the next five years, the company solved the problem in three different ways of compensation. The most commonly used method is to grant the discount on another service (70.8%), permanent discount was offered to 6 customers (accounting for 25% of compensation). Only 1 customer received a financial compensation (complaints about goods damage).

In fig. 2 the reasons for lodging complaints in the above-described period are summarized.

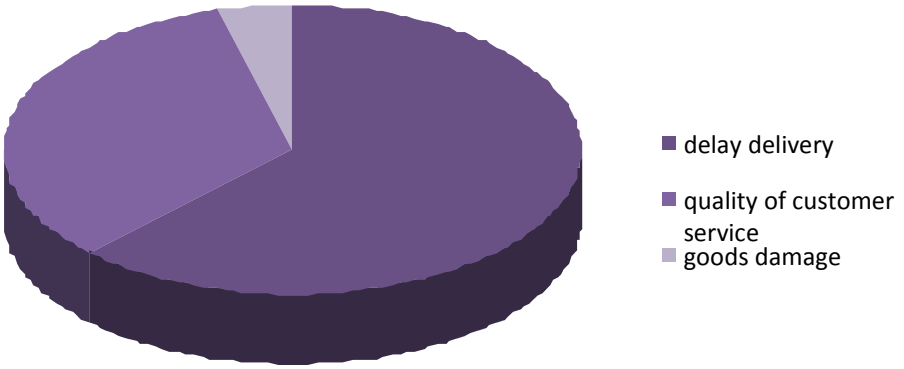

Fig. 2. Reasons for lodging complaints on services provided by the company.

The company operating on the international market should consider the implementation of quality management systems in transport based on the requirements of PN-EN ISO 9001 [6]. The basis for the organization of proper quality management system for companies operating in Poland should be two standards: 1. PN-EN 12507 [7] containing guidelines for solving problems that can cause the introduction of a quality management system in accordance with PN-EN ISO 9001. The guidelines presented in the standard have been developed as an aid in solving problems by reference to the provisions of PN-EN ISO 9001, the use of which may be different and to be taken in order to ensure the effective application of the adopted quality management system; 2. Standard PN EN

12798 [8], which is in addition to the requirements specified in the PN-EN ISO 9001 quality management regarding the transportation of dangerous goods.

3. Conclusion

In order to reduce the number of complaints and dissatisfaction of their customers, in the last few years, the company Run-Trans has taken a number of changes in its transport operations:

- only liquid products used in the food industry are transported;
- limit the area of transportation: primarily on the route: Poland - Benelux (Netherlands, Belgium, Luxembourg);
- long-term contracts with customers.

This strategy results in higher requirements (knowing the company customers should be able to anticipate their needs and provide the appropriate level of service quality). However, this makes it easier to work with customers (employees know the regular customers requirements and knowledge about how to meet their needs). Very high demands are placed on the transport of food - the company must meet the technical and legal requirements [3, 4].

The company's operations in the international market will force adoption of quality management systems in the nearest future. As transport quality management system is an addition to the general requirements for quality management system of transporting company, the condition of transport certification of the quality system is the earlier certified quality management system or simultaneous certification with the transport quality management system according to PN-EN 12798.

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The Drives Behaviour in Various Traffic Conditions

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Abstract. The traffic congestion is a problem for many cities. The citizens complain about stucking in traffic jams and irritate because of wasting their time and money. This situation can cause irritability and unpredictable driver behaviour, leading to collisions and road accidents. Driving in a traffic jam causes frequent use of the accelerator and braking pedal, increasing fuel consumption and air pollution. The aim of this paper is to analyze driver behaviour in various traffic condition.

Keywords: peak hours, driver behaviour,

Introduction

The researchers attempt to assess the impact of psychophysical condition of the driver, road conditions and traffic flow on driver behaviour. Traffic situation can elicit specific emotional state of the driver and impose him to unpredictable behaviour, such as increasing a speed within settled areas or in bad visibility conditions, making a risky overtaking maneuver or lacking of proper interval to preceding vehicles [1,2,4]. The congestion reduces the traffic flow and frustrate the millions of drivers. To people who experience it traffic congestion is irritating because of the time they lose sitting in traffic jams and the frustration of crawling along instead of moving at expected speed. To society as a whole traffic congestion is undesirable because it misallocates scarce resources and causes economic inefficiency and psychological stress [3].

The aim of the paper is an analysis of the driver behaviour in various traffic condition. Some tests were conducted during morning peak hours, the midday hours between morning and afternoon peak hours, at an hour of very beginning of afternoon peak hours and during the afternoon peak hour.

Test procedure

The test route was about 18.8 km long and the tests were conducted under various traffic flow conditions. The route was passed five times at different parts of the day:

1. mornings peak hours at 7:25,
2. midday hours at 11:10,
3. afternoon at 14:07,
4. begin of afternoons peak hours at 15:09,
5. afternoons peak hours at 16:05.

The examined distance (Fig. 1) begins and ends in the northern district of Kielce (Dąbrowa, Warszawska Str., Radomska Str.) and includes the city center (Żelazna Str., Żytnia Str., Ogrodowa Str., Seminaryjska Str., Źródłowa Str.).

The test vehicle was Ford Transit F6 (engine type: 2 198cm3, 125 HP, 92 kW) equipped with:

- CDS- GPS Data Logger – lightweight data logger for various vehicle dynamics testing applications Kistler®;

- optical sensor S-350 Corrsys Datron ® for slip free measurement of longitudinal and transversal dynamics (Fig. 2a);
- uEEP 12 Corrsys Datron® high - performance data acquisition and evaluation system for mobile vehicle testing applications. with the tablet controller and software ARMS® (Fig. 2b);
- navigational sensor TANS for dynamic yaw rate measurement (simultaneous up to 6 axes: 3 axis gyro and 3 axis accelerometer);
- WIRE POT D8 potentiometer winding sensors for measuring displacement of control pedals: acceleration pedal, service brake to determine the movement of each pedal - in order to determine the driver's behaviour (Fig. 2c).

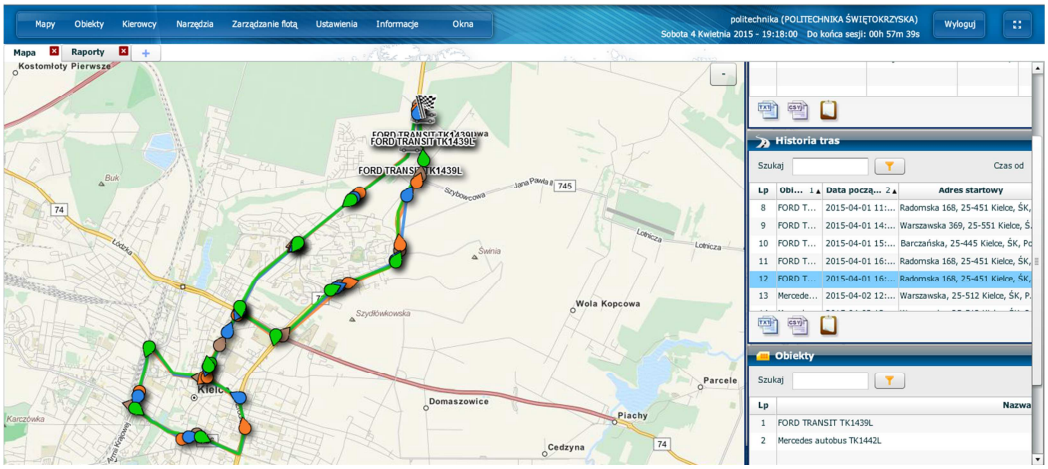


Fig. 1. Movement trajectory of the test vehicle registered by Globtrak®

Fig. 2. The test vehicle equipment

The test equipment allows to analyze the different driving conditions in the prescribed city districts, including:

- average velocity of vehicle,
- displacement of accelerator and brake pedal,
- travelled distance,
- trajectory move of the vehicle, with position (latitude and longitude) and height,
- fuel consumption.

Results an verification

Fig. 3 presents differences in velocity values measured by S-350 sensor and GPS Data Logger. Both measurement methods have achieved convergence of measured values.

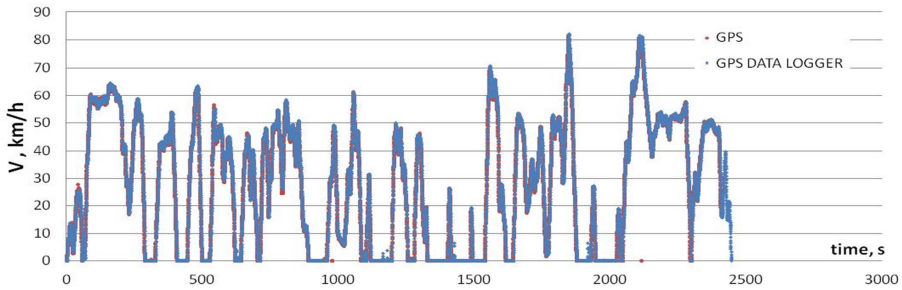
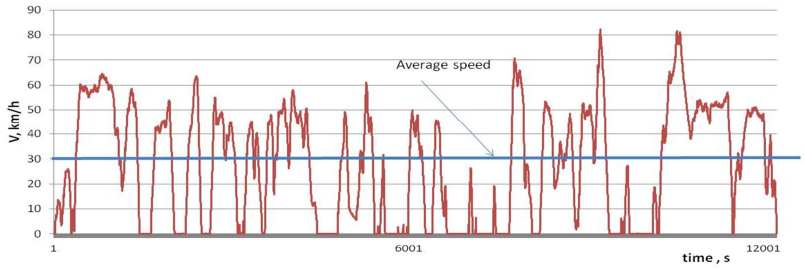


Fig. 3. Velocity values measured by S-350 sensor and GPS Data Logger

Fig. 4. presents instantaneous velocity measured during each of five passages. The values were diverse. The average speed values of each passage were different and depended on the time of a day. For the first passage the highest average speed (29.82 km/h) was recorded.

1



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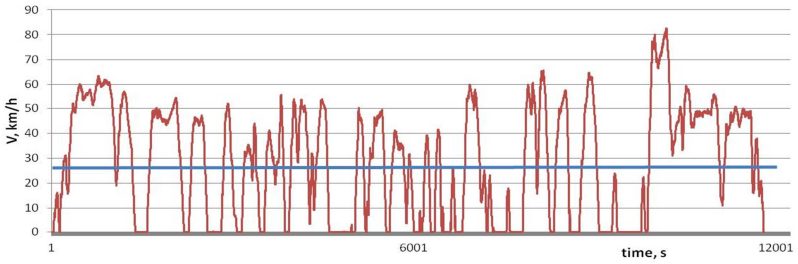

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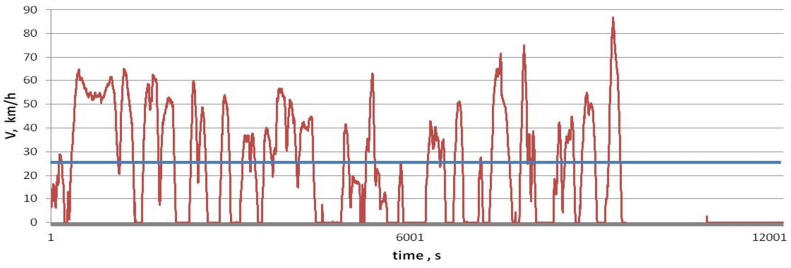

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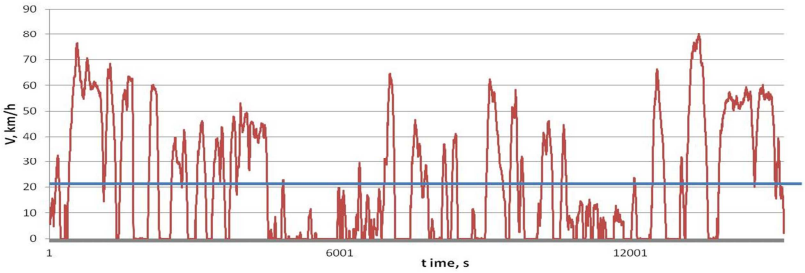

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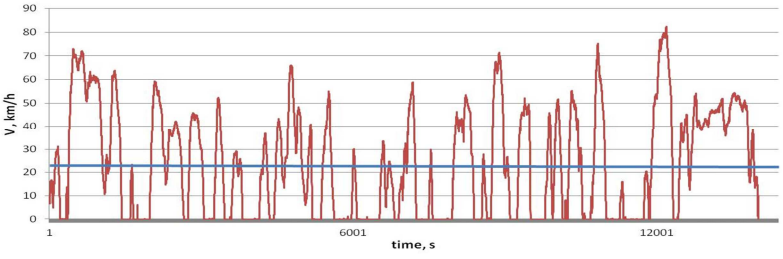

Fig. 4. The average and instantaneous values of velocity

The average velocity values calculated for the subsequent passages were 25.36 km/h, 26.34 km/h, 21.62 km/h and 23.44 km/h. The significant differences were observed for the stationary movement of the vehicle. The difference between 1st and 5th passage time was about 11 minutes. The driving time measured for the 5th passage was approximately the same as the time of stopping.

Displacements of the accelerator pedal are presented on a Fig. 5. The driver pressed the accelerator pedal (displacement of above 90%) 16 times during 1st passage, 33 times during 2nd passage and 21 times during 3rd passage. The fuel consumption calculated for each of this three passages was about 1.9 dm^3 (after recalculating 10.1 dm^3 per 100km). During the 4th passage the driver pressed the accelerator pedal 10 times. During this passage the lowest fuel consumption was recorded: 1,6 dm^3 (8.5 dm^3/100km). During the 5th passage the driver pressed the accelerator pedal 40 times. It caused the highest fuel consumption - 2.9 dm^3 (15.2 dm^3/100km).

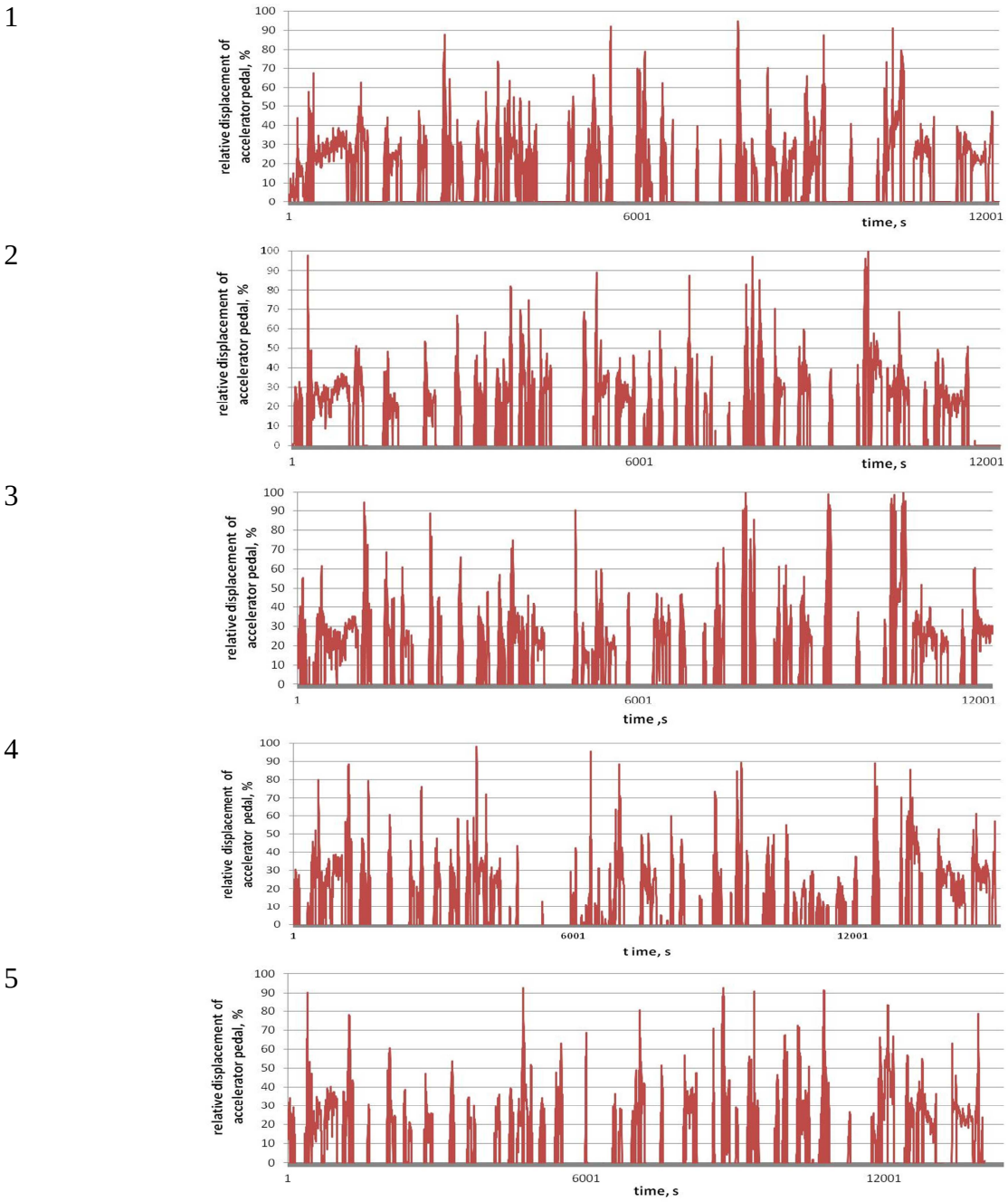

Fig. 5. A movements of the accelerator pedal

Fig. 6. shows a movement of brake pedal. The time, when the braking pedal is in use for each passages occur successively: 16min 52sec, 17min 21sec, 19min 58sec, 26min 21sec and 24min 27sec.

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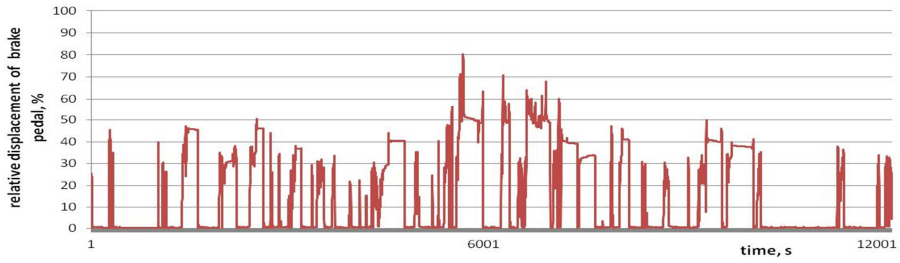

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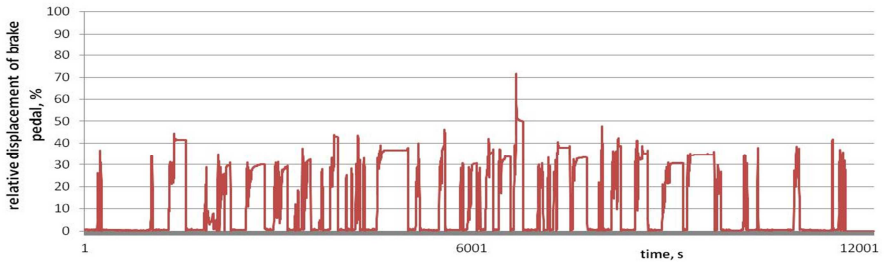

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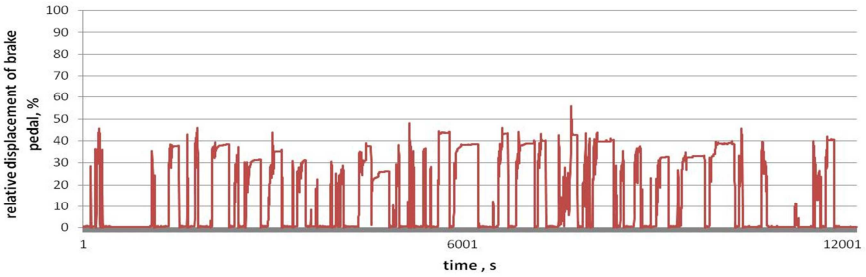

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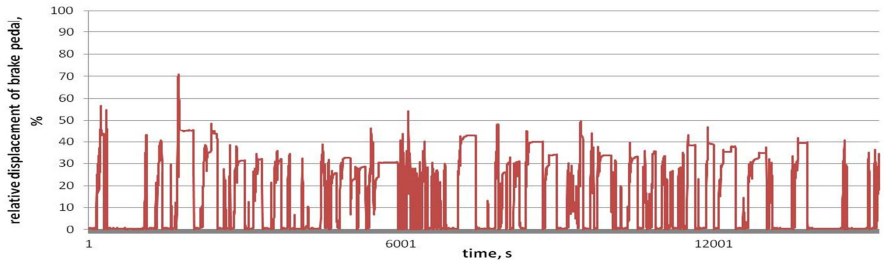

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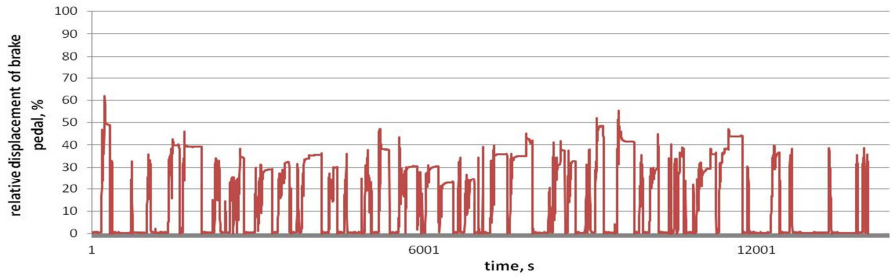

Fig. 6. Displacements of the brake pedal registered during the tests

Conclusion

The results of the tests confirm the predictions. The lowest values of average velocity were recorded during passages conducted in peak hours. The driver was imposed to frequent usage of the acceleration and brake pedals. The traffic congestion cause the driving time and stopping substantially longer. The traffic jams could be observed mainly in the city center. The driver could shorten time of journey driving more aggressively on the entry streets.

The researches allows us to explore the prevailing traffic conditions in Kielce and introduction to further studies. The next step of our work is to create a driving cycle for the Kielce and consideration of implementing the alternative propulsion in public transport vehicles.

Acknowledgement

This paper is based on subsidy from LABIN – *Wsparcie Aparaturowe Innowacyjnych Laboratoriów Naukowo – Badawczych Politechniki Świętokrzyskiej w Kielcach* projekt nr POPW.01.03.00-26-016/09, *„Ruchome laboratorium badań bezpieczeństwa i komfortu w transporcie zbiorowym”* WND-RPSW.02.01.00-26-012/11, *„Ruchome laboratorium badań bezpieczeństwa i własności dynamicznych pojazdów samochodowych”* WND-RPSW.02.01.00-26-010/11 and *Modernizacja i rozwój infrastruktury dydaktyczno - badawczej dla innowacyjnego kształcenia na kierunku Transport* nr WND-RPSW.02.01.00-26-011/11.

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Illumination Distance and Sight Distance of Headlamps

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Abstract. The article deals with the issue of illumination the road vehicles and its impact of individual light sources positioned in the vehicle headlamps to illuminate the road in the corridor of movement of the vehicle. The first section provides a description of the specific light sources in headlamps and characterizes their illumination distance and sight distance. The second part presents the results of experimental measurements, whose aim was to measure the illumination distance and sight distance using different light sources.

Keywords: illumination distance, sight distance, halogen bulb, discharge bulb

1. Introduction

Lighting and lamp signaling significantly affect the active and passive vehicle safety in road traffic. Light vehicle device is a device designed to illuminate the road or to emit a light signal to other users of the roads. Headlamps have to shine as the driver the most disseminate the visible area in front of the vehicle, with the least glare for oncoming traffic.
Lighting technology is one of the basic conditions for the operation of vehicles on the road. The primary task of vehicle is illuminate the road, the driver of road vehicle seen and was viewed. Depending on the light source in the headlamp, changes the distance of illumination the road. Although the headlamps of vehicle illuminate the road it does not mean it is illuminated effectively. The distance of effectively illuminate area the road call sight distance and on this distance is the driver able to detect possible object on the ground.

1.1. Light sources

The current road vehicles use a various different light sources operating on different principles. A common light source for electrical equipment of road vehicle is light bulb, conventional tungsten filament in a vacuum environment with halogen iodine or bromine couple or latest incandescent light. Their voltage is determined by basic source of voltage the road vehicle (6 V, 12 V, 24V). [1]

1.2. Standard Light Bulb

The basic source of light in the road vehicle is standard light bulb with tungsten filament. The operating life of the lamp is given by currency tungsten filament, that during operation slowly evaporated and the molecules of metal are deposited on the inner surface of the flask whereby are worsen the optical properties. This appearance manifests itself blackish bulb. Operating life the standard light bulb is three times smaller compared to halogen bulbs. The bulb emits of the heat energy 90% and about 10-12% of the light energy. The result is that the luminous efficiency of standard light bulb is relatively low. [2]

1.3. Halogen bulb

Compared to standard light bulbs vary the composition of filing in bulbs. Contain in addition to inert gas some of hall elements, most often iodine and bromine optionally. It is used in them iodine cycle. Tungsten release from the fibers at high temperature (evaporation temperature) gets on the glass inner sheath, where the temperature is lower. There combines with iodine and produces iodide tungsten. Iodide gets to the molten fiber which covers the components, wherein the tungsten is deposited on the fiber and iodide is released into the cartridge. It means that the tungsten cyclically released from the fiber and again bound to the fiber. [1]

Fig. 1. Halogen bulb H4 [9]

Bulb of the halogen bulb has a very small size to be able in the operation warm up to approximately 300°C. The evaporated tungsten particles were carried out through a chemical process and settle again on the hottest place of filament. The tungsten evaporated does not settle on the bulb, the bulb remains clean. [1]
Halogen bulbs have double luminous flux at the same wattage than the standard bulb, better colour performance and using appropriate reflectors achieves better uniformity od illumination of the road surface ahead the vehicle shown in Figure2.

Fig. 2. Efficacy of headlamp with standard bulb and halogen bulb [3]

Another advantage of halogen bulbs are better properties in terms of adaptation of the eye the driver on the change brightness when switching high and low beam of headlamps, which reduces the effects of glare and visual fatigue during night driving. Halogen bulbs used in vehicles are manufactured in various designs. The most common types are mainly H1, H4 and H7, which shown Figure 3.

1.4. Discharge Lamp

Discharge lamp is a high performance light source. It consists of the glass sealed with the electrode, which is filled with an inert gas. The bulb is made of pure silica glass. In the field of electric shock is bulb about the size of a pea. Jump spark between leads to ionization gas tank and

creates an electric arc that starts to burn and creating a light source. The environment in which the arc is burning (xenon, steam and alkali metal salts) determines the colour of the bulb light in the range of 4100 ÷8000. The colour of the resulting electric arc influences the composition of the use of inert gas. [4]

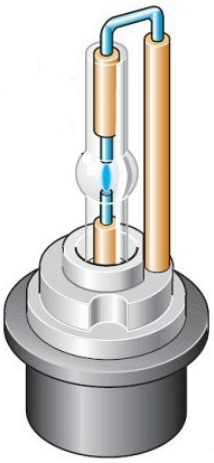

Fig. 3. Discharge bulb [4]

Figure 3 shows the discharge bulb. The intensity of resulting light is twice higher compared with halogen bulb and light spectrum comparable to daylight. It has a five times higher service operation life, of about 2500 hours and one-third less consumption. Discharge bulbs are fitted only to the low beam and high beam is halogen, in mode of high beam the low beam discharge bulbs remains lit and the halogen high beam switched only. Discharge headlamp is therefore a combination of discharge bulb and halogen bulb. Standard discharge headlamps are just as low beam, high beam procured classic halogen bulb.

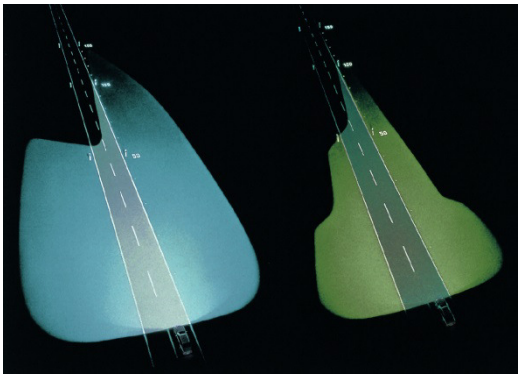

Fig. 4. Comparison of the efficacy the xenon bulb and halogen bulb [5]

At the figure 4 is a comparison the intensity of illumination the road by headlamps with discharge bulbs and halogen bulbs places in mode of low beam.

2. Illumination Distance and Sight Distance

Illumination distance and sight distance in front of the vehicle are not the same distances. Although the headlamps of vehicle illuminate the road only a part of this distance is illuminate effectively.

2.1. Illumination Distance

Illumination distance of road means in case of high beam the distance, when the driver of road vehicle recognize objects on the road or shoulder. In mode of low beam it is the distance the low beam illuminate road, respectively distance where the interface is lit and unlit section of road. [6]
Maximum illumination distance of headlamps from the front of the vehicle provides satisfactory adjustment of headlamps. Incorrect adjustment of headlamps leads to dazzle drivers of oncoming traffic and thereby to endanger road safety. Illumination distance of headlamps on the road is limited by the angle prescribed by the manufacturer for the basic setting of the headlamps, which must be met for the whole range of the load.
For vehicles with halogen bulbs the setting angle of headlamps is carried out manually, usually the dial located on the instrument panel. For vehicles equipped with discharge headlamps is the angle of headlamps carried out automatically by a system of automatic level control. [7]

2.2. Sight Distance

The sight distance is the distance ahead vehicle on which is the road efficient illuminated. On this distance is the driver able to observed the object on the road and evaluate it more. This distance is not a constant value, but it changes during the driving. When vehicles are traveling at the night the effective illumination of the road ensure headlamps of the vehicle. Space effectively illuminate the road is bordered by isolux curve. It is a space where the light intensity is greater than 1, 50 lux. It should be known that the object is situated at the distance of illumination limit in the plane of the road, has illuminated only the lower edge at the point of contact with the ground wire and it can be not observed. The object can be observed only when is effectively illuminated about the high 0, 40 to 0, 50 m above the ground level. [8]

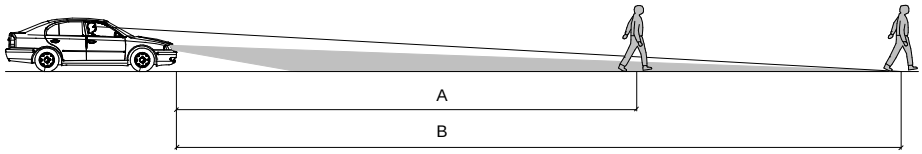

Fig. 5. Sight distance and illumination distance [8]

Figure 5 shows the illuminated distance ahead of the vehicle in the plane of the road as the illumination distance (distance B) and effectively lit area ahead of the vehicle as the sight distance (distance A).

3. Experimental Measurement

The aim of the measurement was to determine the values of illumination intensity in different parts of the body helper depending on the specific light sources and also to determine the maximum illumination distance selected headlamps. Values the intensity was measured in the area heel of pedestrian, approximately 2 cm about the ground plane. Measurements were made on three vehicles.
The first car was the BMW E46 330xd where the mode of high beam operates halogen bulb H1 and mode of low beam discharge bulb DS1. Second car was Audi A4Avant 1.9 TDI where the mode of high beam operates halogen bulb H7 and mode of low beam halogen bulb H7 with the angle prescribed by the manufacturer 1%. Third vehicle was Volkswagen Passat where the mode of high beam operates halogen bulb H7 a mode of low beam halogen bulb H7 with the angle prescribed by the manufacturer 1 %.
In Figure 6 is the graphically pictured trend intensity of illumination depending on the distance pedestrian from the vehicle in mode of high beam on the heel of pedestrian. Obviously, from all of

three vehicles reach the longest distance of illumination of road vehicle BMW with halogen bulb H1.

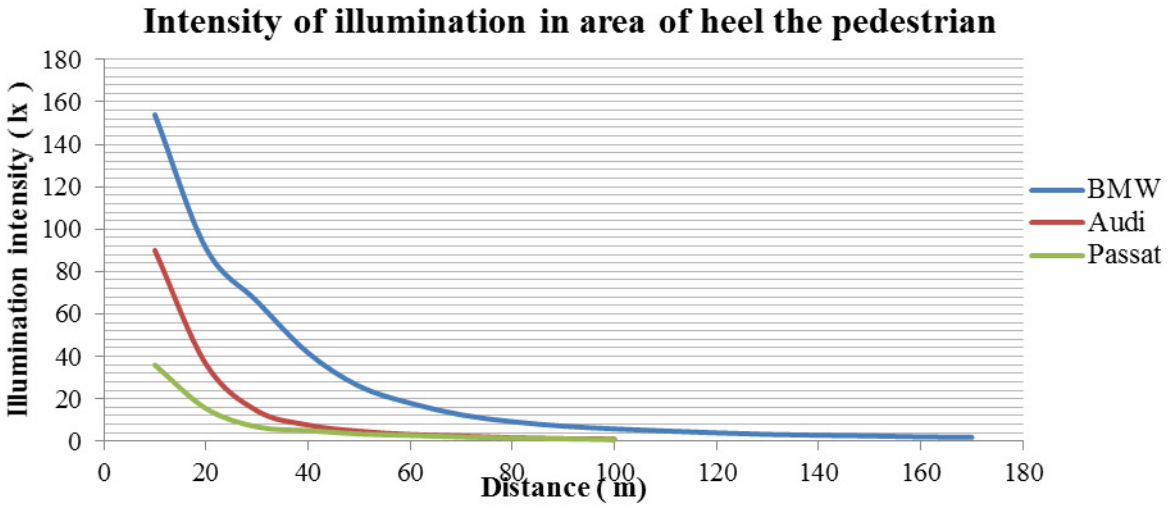

Fig. 6. Intensity of illumination the pedestrian in mode of high beam in area of heel

Illumination distance of the Audi A4 and Volkswagen Passat with halogen bulb H7 achieved in mode of high and low beam the same distance. The highest values of illumination intensity were measured at the distance of 20 meters in front of the vehicle. At least intense illumination produce headlamps the vehicle Volkswagen Passat in mode of high beam and a value of 36 lux in the heel area at a distance 10 m from the vehicle.

The values intensity of illumination measured in mode of low beam for all tree vehicles are shown graphically in figure 7. Halogen bulbs H7 places in headlamps of the vehicle Audi A4 and Volkswagen Passat achieved compared with discharge bulb in headlamps of the vehicle BMW far lower intensity of illumination.

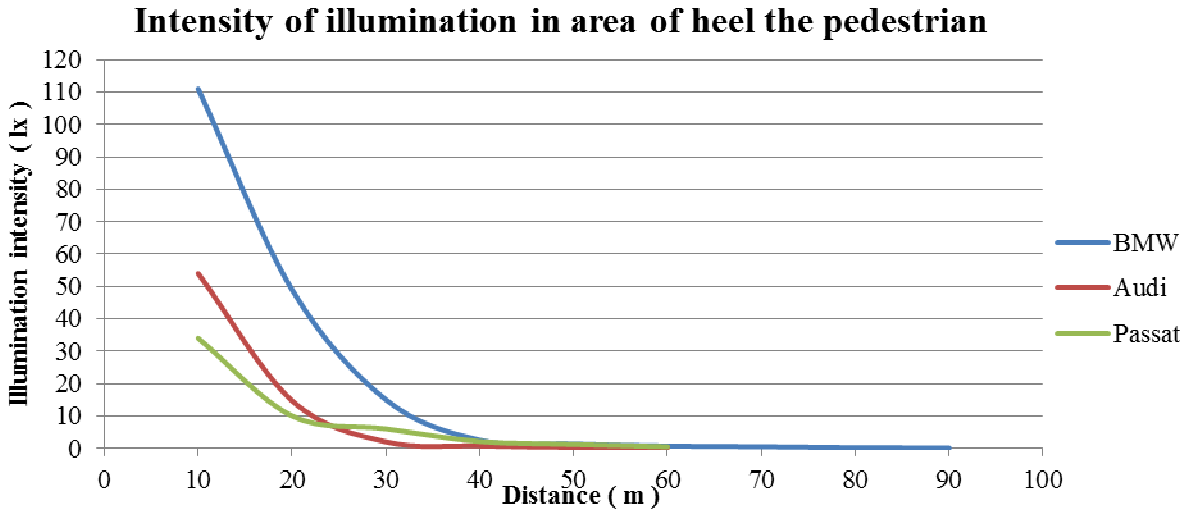

Fig. 7. Intensity of illumination the pedestrian in mode of low beam in area of heel

The measured value of intensity 10 m in front of vehicle with discharge bulb reaches 111lux at a height of about 2 cm above ground level. With the vehicle Audi A4 is the value of intensity 54 lx and Volkswagen Passat only 34 lx. Thus, halogen bulbs achieve less than half intensity of illumination compared with xenon bulbs. Illumination distance with xenon bulbs DS1 is 90 m in mode of low beam and with halogen bulbs is 60 m to both vehicles, a difference of 30 m.

3.1. Comparison Illumination Distance and Sight Distance

Based on the measured values intensity of illumination was determined illumination distance of each headlamps. In practice, the concept illumination distance is sometimes identified with the term sight distance. From the measured values is obvious that the illumination distance and sight distance are not identical and are significant differences among them. The smallest difference of these distances is in mode of high beam the vehicle BMW with halogen bulb H1 and this 10 m. In mode of low beam with discharge DS1 is the difference up to 50 m. Low beam illuminate the road to a distance 90 m, but only 40 m of this section is illuminated effectively, thus the value of 1,5 lx at a certain height of the road.

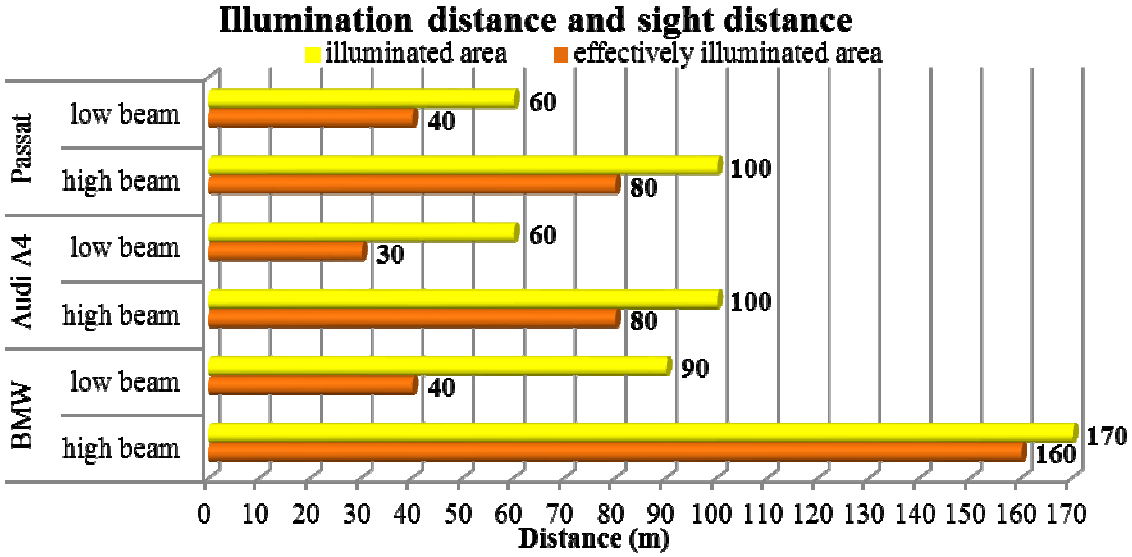

Fig. 8. Illumination distance and sight distance

Illumination distance in mode of high beam the vehicles AudiA4 and Volkswagen Passat using halogen bulbs H7 is the same. Corridor for the vehicle is illuminated at a distance of 100 m; 80 m of this distance is illuminated effectively. Illumination distance in mode of low beam is for both vehicle 60 m. The difference is in sight distances, where Audi A4 is 30 m and Volkswagen Passat is it a distance 40 m. The smallest difference between sight distance and illumination distance of headlamps is in mode of high beam with halogen bulb the vehicle BMW, it is 10 m and the biggest difference is in mode of low beam with discharge bulbs up to distance 50 m.

4. Conclusion

Measurements show that the using of halogen bulb H1 reached headlamps of vehicle BMW the greatest illumination distance 170 m and using of discharge bulb DS1 in mode of low beam reached 100 m. Headlamps of the Audi A4 and Volkswagen Passat achieved the illumination distance 100 m in mode of high beam with halogen bulb H7 and in mode of low beam the distance 60 m with halogen bulb H7. It is important to realize that between illumination distance and sight distance is difference. It follows even if is in front of vehicle illuminated area only part of this distance is illuminated effectively.

Acknowledgement

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The Analysis of the Motor Vehicle Electrical Parameters and the Interpretation of the Electronic Systems Data in order to Determine the Actual Motor Vehicle Mileage.

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Abstract. The article presents the analysis of electrical signals and system reports of motor vehicles in which the mileage counter indication has been questioned under service conditions as compared to the vehicles mechanical wear and tear. The essence of the aforementioned deliberations is an attempt at determining the universal procedures allowing for obtaining data concerning the actual vehicle mileage. Search for the intended method results from many factors functioning on the used motor vehicles market. The major factor is the uncontrolled safety level on the roads among the road users and, equally important, financial frauds in the area of motor vehicles sales, as well as vehicles cost estimation by the insurance companies. The following material provides an excellent starting point for the creation of systematic research on the issue.

Keywords: vehicle mileage, technical condition, mechanical wear and tear

1. Introduction

According to the data collected by the company 'Motoraporter', involved in the technical expertise of the used motor vehicles all over the territory of Poland, the 2014 summary presents the proportions described below. During the year about 1,000,000.00 transactions were registered on the used motor vehicles market, among which 23% constituted domestic origin vehicles and 77% were the imported vehicles. The relation of transactions between private persons and dealers was 32% and 68% for second-hand car dealers and dealer's markets. The percentage of Poles purchasing motor vehicles from car dealers is minor, nevertheless, it is worthwhile to state, that majority of the cars purchased by Polish people is 4 - 8 years old (53% of all inspected vehicles). For the purpose of comparing, the percentage of inspected vehicles dated 1990 - 1995 was only 3%. Cars dated 2011 and newer constituted 15% of all inspected motor vehicles. Last year the station wagon type of vehicles prevailed, and the most popular engine was Diesel (increase from 60% to 72%). The mileage of the inspected vehicle is a curiosity. The greatest number of vehicles, among the inspected ones, constitute those dated 2006 - 2010. We also know that imported vehicles constitute the majority. According to the statistics, an European annually drives about 30,000.00 km. Relatively, it means the mileage between 120,000.00 and 240,000.00 km. Among the inspected vehicles the declared mileage usually was between 101,000.00 and 150,000.00 km. The mileage exceeding 200,000.00 km was very rare (6% of the inspected cars), and if we would like to follow the statistics, it should possibly occur regularly. It has been also confirmed by the reports prepared by the company experts, informing that over 35% of the inspected vehicles had 'fraudulent' indications of the mileage counter. The data above present that the procedure of lowering the mileage counter indication, in spite of being illegal, is commonly employed, which in turn means the overestimation of the vehicle value and drastic decline of the safety level.

2. The Analysis of the Internal Combustion Unit Signals

The implementation of the continuously increasing ecological requirements has forced the motor vehicles manufacturers to exceptionally develop as regards the internal combustion unit metering and the permanent supervision over its operating parameters. The technological advancement and the toxic substances emission limits have also caused the complete alteration of the diagnostic procedures applied for the contemporary vehicles. The necessity of applying modern diagnostic tools such as diagnoscopes dedicated to car brands, or universal tools, allow for the real-time viewing of the unit operation parameters, by means of the serial diagnostics method, with the application of the CAN bus. The limited life span of particular combustion unit components resulting from their precisely calculated number of work cycles in order to maintain the correct ecological parameters, is a perfect tool to make an attempt at deducing the actual vehicle mileage. It is applicable to the spark-ignition engines as well as to the compression-ignition engines. One of the elements which is directly connected to the mileage is the dust saturation of the diesel particulate filter in compression ignition engines (Picture 1).

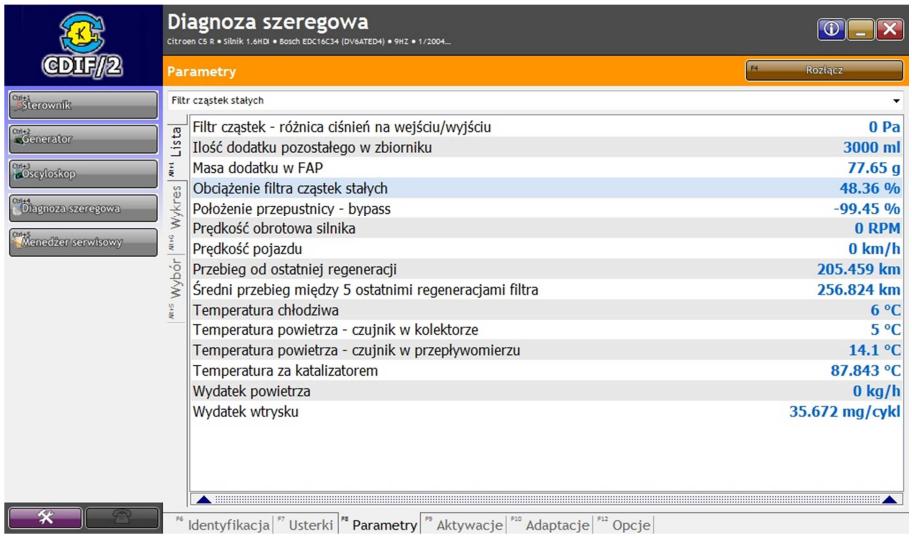

Fig. 1. CDIF2 Diagnostic Program window – diesel particulate filter saturation and the regeneration process regularity of the PSA Group vehicle readout [author's own material]

This parameter informs the diagnostician not only about the environment in which the vehicle was driving, but also about the number of successful regeneration processes, therefore, what the approximate vehicle mileage is. Nominal DPF/FAP type filter is prepared for the maintenance-free mileage of about 350,000.00 km. For example, for the 1.9 TDI unit, engine code BLS, power 105 km, VW Group, the foregoing mileage means the dust content at the level of 60 g (Picture 2).

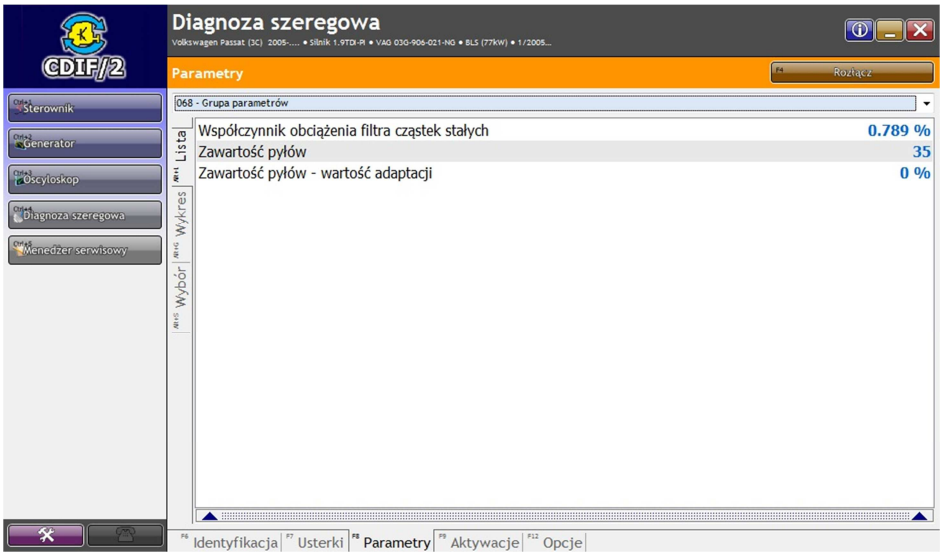

Fig. 2. CDIF2 Diagnostic Program window – dust content parameter for the PSA Group vehicle readout [author's own material]

What is more, the significant element indicating the condition of the system for cleaning fumes from the carbon particles is the regeneration frequency and regeneration intervals factor. In case of an attempt at the mechanical disposal of dust, there will remain information in the control concerning the interval between burning. Another element, which directly influences the vehicle mileage is determination of the vehicle injection system condition - compression-ignition engine. The example of such a case is the fuel injection correction parameters readout on the particular fuel injection valve. At the moment the parameters, as in the Picture 3 are obtained, which means the significant discrepancy on the single injection, such state means the system damage and breakdown.

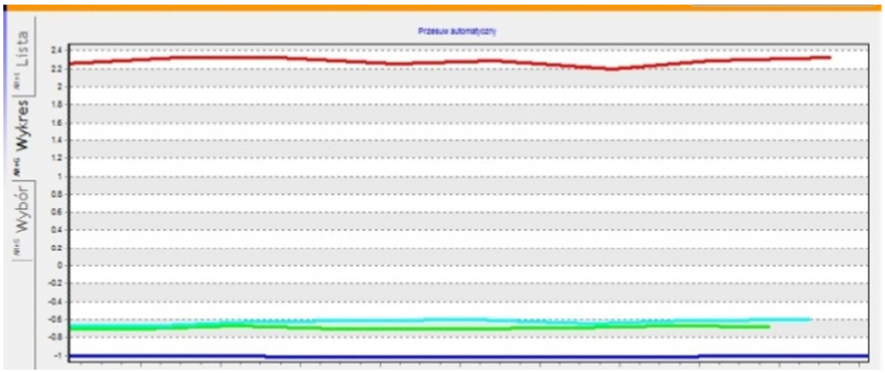

Fig .3. CDIF2 Diagnostic Program window – graphic visualisation of the fuel injection correction for vehicle Fiat 1.9 JTD [author's own material]

Another case is to identify the state of even balance of the significant injection dose corrections (value of about +/- 1 mg). Such a state means the even wear and tear of the fuel injection valves, which in turn means the significant vehicle mileage. The example of the balanced readout of the injection dose correction parameters is presented in the Picture 4, which shows the data of VW Group vehicle, 1.9TDI unit, BXE code with the mileage of 165,000.00 km.

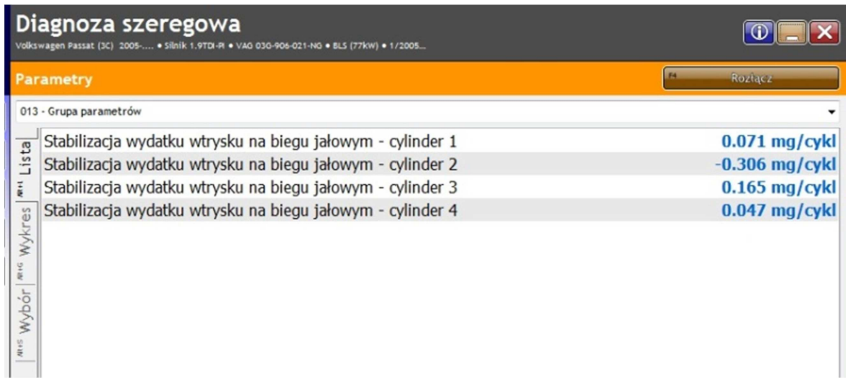

Fig.4. CDIF2 Diagnostic Program window – fuel injection dose stabilisation parameters readout [author's own material]

In case of the attempt at the mileage identification in case of the spark-ignition engine vehicle, it is crucial to try to determine the catalyst system wear and tear and inertia condition of the oxygen controlling sensors (lambda probes). Similarly to the diesel particulate filter, the three-way catalyst system efficiency is scheduled for a particular number of cycles equals to the mileage of about 180,000.00 - 250,000.00 km. The voltage or current signal (Picture 5) is the parameter indicating the catalyst wear and tear, depending on the oxygen sensor type - lambda probe.

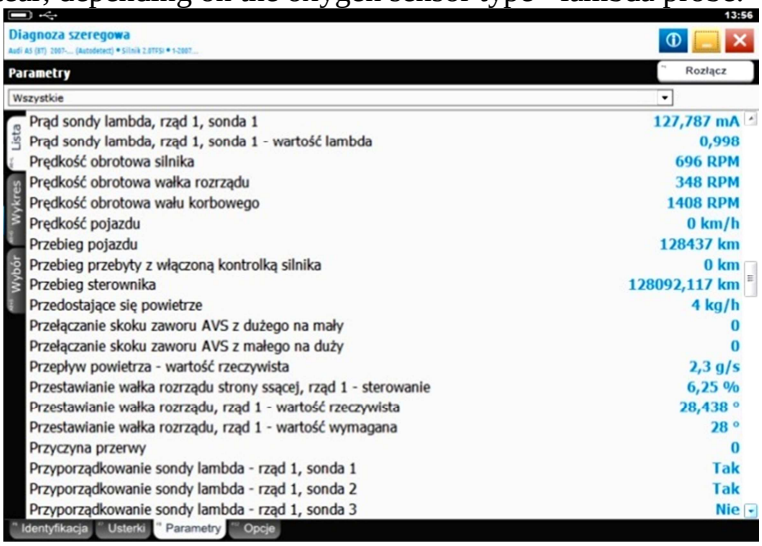

Fig. 5. CDIF3 Diagnostic Program window – lambda probes working parameters [author's own material]

The window above constitutes the presentation of the current scale of broad band oxygen sensors in the VW Group car with the spark-ignition engine with the direct injection of the TFSI type fuel. It is worth to note that the value of the actual vehicle mileage is among the parameters connected with the fumes cleaning system. It corroborates the rule concerning the dispersion of data concerning mileage in various system modules. However, this issue is going to be analyzed in more detail in the subsequent chapter. Picture 6 constitutes the presentation of the registered breakdowns connected with functioning of the catalyst system and lambda probes.

Fig.6. CDIF2 Diagnostic Program window – reaction time exceeded failure of the lambda probe [author's own material]

The exceeding of the probe voltage maximum may be the sign of the fuel injection system damage as well as the wear and tear resulting from the exceeded operation cycles. The complementing inspection is the visualisation of the probe voltage signal on the diagnoscope. If the obtained chart does not reach the time amplitude below 1 second with 2000 revolutions per minute of the internal combustion unit, it will mean the lost inertia of the oxygen sensor, resulting from its wear and tear.

3. Consistency of the Systems Data Readouts with the Vehicle Mileage

The already mentioned in the first chapter mileage dispersal system, ensures the possibility of obtaining access to the vehicle mileage readout in various electronic modules. Apart from the mileage indication in the vehicle mileage counter, it is placed in the following components: key (picture 7), engine driver, power steering module, air conditioning, or xenon lights driver.

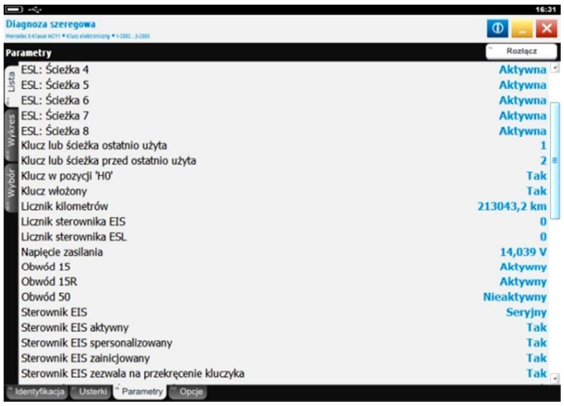

Fig .7 . CDIF3 Diagnostic Program window – Actual parameters of the key module readout vehicle MB W211 [author's own material]

Such dispersal of the mileage information has two objectives. First of all, the vehicle mileage parameter is, indeed, an important information for the module functioning, e.g. in the key, since it registers precise date and course of the damage occurring in the vehicle to be data carrier for the service purposes. Functioning information concerning the vehicle mileage in the lights module allows for the active control over the light source wear in order to maintain the optimum safety level. Registration of the mileage parameter in the power steering module is done by means of the hours of operation registration. That is why, for example in the vehicle where the operation of the electric and hydraulic power steering amounted to 1830 hours (Picture 8), in order to obtain the

approximate vehicle mileage, you have to multiply the hours of operation by average local roads driving speed. In Poland this value is assumed to be at the level of 45 km/h.

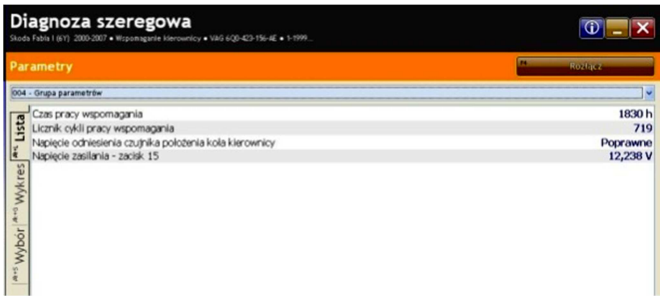

Fig. 8. - CDIF3 Diagnostic Program window — hours of operation in the power steering system readout VW Group vehicle [author's own material]

The obtained value should be close +/- 5% to the mileage counter indications. Of course the extend of the problem, not only in Poland but also in Europe, is so high, that there are first diagnoscopes available on the market with the function of the mileage readout from the engine module, e.g. EDC16 and comparing it to the mileage counter indication. Even though many discrepancies could be seen only on the basis of this example, the comparison of two modules is still not enough. The proper certainty level as to the mileage could be ensured by the tester allowing for the comparison of the mileage data taken from all available in the vehicle modules and the tester assessing the consistency of such indications.

4. Conclusion

In this work, the main sources of readout of the electrical data directly connected with the vehicle mileage have been indicated on the basis of many cars manufacturers. The analysis of the aforementioned data allows for proposing a thesis that there is a possibility of defining quite precisely the actual vehicle wear level on the basis of the interpretation of the actual parameters connected with the driving unit and the remaining system modules functioning within the vehicle. It seems to be reasonable to make an attempt at defining common directions and procedures allowing for straightforward and consistent description of the vehicle mileage, in order to reduce the wheedling of money from the insurance companies and to increase the Polish roads safety.

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Possibilities of Braking Deceleration Measurement

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Abstract. This contribution deals with the issue of car braking, particularly with the one of M1 category. Braking deceleration measurement of the vehicle Mazda 3 MPS by the declerograph XL Meter^{TM} Pro was carried out. The main aim of the contribution was to investigate the process of braking deceleration of the vehicle Mazda 3 MPS. The test took place at the Rosina airfield, the airstrip in a small village nearby the town of Žilina. The last part of this paper presents the results, evaluation and comparison of the measurements carried out.

Keywords: braking deceleration, braking time, braking distance, decelograph XL Meter^{TM} Pro

1. Introduction

Road traffic safety regulation require vehicle to be able to stop within distance. The reaction pathway depends on the driver's speed of reaction, concentration, experience and immediate mental a physical condition. The driver does not change direction or speed of a vehicle during the phase from noticing obstacle to the stopping of the vehicle. The stopping distance of a vehicle is determined by several factors which affect tire grip such as weather conditions (e.g. rain, fog, lighting conditions), geography (e.g. slope traverse plane), speed, quality and type of tire. The driver scope is influenced by density of transport flow, the driver's view of traffic flow (e.g. saddle, peak), topography and environment. [3]

Indeed, the detection of the real value reached during intense vehicle braking is one of the key factors in the process of accident investigation. [2]

2. Test vehicle

Mazda 3 MPS 2,3 MZR DISI model year 03/2011 was used as the test vehicle (Fig. 1). It was loaded with one person (a driver) at the moment of the tests. The tires of Pirelli brand were of 205/50/R17 93 dimension with the 5.1 mm tread depth of the front tires and 5.7 mm of the rear ones.

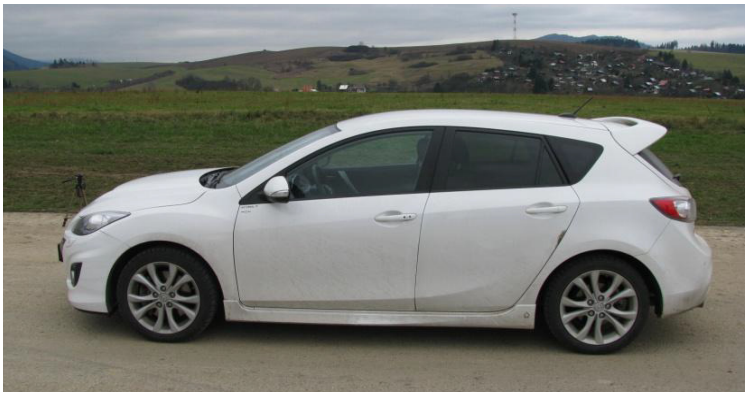

Fig. 1. Mazda 3 MPS 2,3 MZR DISI

The safety systems effecting the braking force installed in the vehicle include: ABS (Anti-lock Braking System), EBD (Electronic Brakeforce Distribution), EBA (Electronic Brake Assist), DSC (Dynamic Stability Control), TCS (Traction Control System), LSD (Limited Slip Differencial), active seat belt tensioners, EBS (Emergency Brake-light System).

3. Measurement devices - decelograpf Inventure XL Meter™ Pro

Measurement device XL Meter™ Pro of the 3rd generation was used for measuring (Fig. 3). It is a universal accelero/decelerometer with the alphanumercid LCD display. It serves to measure and evaluate vehicle acceleration and the state of its service brakes; it´s easy to operate as it uses only 3 buttons placed at the top of the device box, each of them being of a different colour (black, green, red) and therefore of a different function. [6]

The device is powered by a battery but it can also be connected via an external source. From the technical point of view, it consists of three main parts: electronics, a vacuum suction cupule and an articulated arm which allows customizable mounting. XL Meter™ Pro is easy to attach to the desired location on the surface of the vehicle windshield or any other smooth surface and it can be fixed to the surface by turning the lever of the vacuum suction cupule. The device is built-in into an aluminium box which is purpose-designed to provide easy controlability and installation. The articulated arm allows zero point calibration while being installed on the vehicle windshield by means of the vacuum suction cupule.

There are two slots at the back panel; nine-pin D-SUB connector RS-232 allows connection with the computer and it may also be used to connect the brake pedal sensor as well as output signal control and the round slot is used to power the device from the external source (CC-in adapter). [4]

The 14-bit measuring technology has been improved in the process of new HL Meter™ Pro development. Thanks to its increased storage capacity it is now possible to realise 8 measurements without the necessity to transfer data directly into a computer. The new functions of synchronisation and remote control enable easier and more comfortable usage. The modular architecture makes XL Meter™ Pro the ultimate device either for speed-up or brake performance tests. [5]

The electronic system of the device continuously records values of output signal voltage during the measurement, with the sampling rate of 200 Hz, i.e. the values are measured and recorded every 5 ms. There is an automatic off position recognition built-in in the device, so the precise zero point setting is not that necessary. The device records the course of acceleration within a span of 40 seconds from the moment of being turned on. After the measurement is over, the screen displays the value of mean fully developed deceleration (MFDD), the braking distance (s_0), the initial velocity (v_0), and the intensive braking time (t_{br}). [4]

Mean fully developed deceleration (MFDD) is on the basis of norm EHK 13 calculated as the mean deceleration regarding the distances travelled in the interval from v_b to v_e in accordance with the formula [1]. Individual parameters appearing in the formula can be also represented graphically (Fig. 2).

$$MFDD = \frac{v_b^{\,2} - v_e^{\,2}}{25{,}92 \cdot (s_e - s_b)} \qquad (1)$$

where:
MFDD – mean fully development deceleration [$m.s^{-2}$],
v_o – initial vehicle speed [$km.h^{-1}$],
v_b – vehicle speed at 0,8 v_o [$km.h^{-1}$],
v_e – vehicle speed at 0,1 v_o [$km.h^{-1}$],
s_b – distance travelled between v_o a v_b [m],
s_e –distance travelled between v_o a v_e [m]

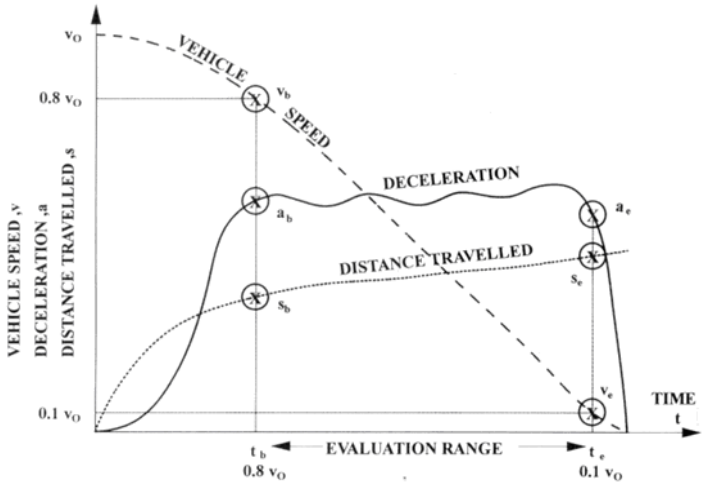

Fig. 2. Dependence of vehicle speed, distance travelled and braking deceleration for the calculation of MFDD

4. Measurement and measurement method

The experiment was carried out on 30 November 2014 at the Rosina airfield. The surface conditions were: dry asphalt runway with the estimated adhesion factor of range 0.80-0.90 and the runway temperature was of 6 °C. The temperature of ambient air was 3 ºC with low speed wind so we could ignore its impact on the measurement. The length of the experimental track was approximately of 250m. Certain measurement inaccuracy was caused by the surface gratient estimated at 2%.

Measurement device XL Meter^{TM} PRO was installed on the inside Mazda 3 MPS 2,3 MZR DISI windshield by means of the vacuum suction cupule (Fig. 3).

The decelerograph was fixed by means of the vacuum suction cupule on the inside windshield during the measurement. The device was positioned in a way so that its measuring axis was parallel to the drive direction and so its controls were within reach of operation.

The device switches into calibration mode after being switched on and successful completion of the automatic system control. The mode then displays current value of measured acceleration. If a vehicle stands still on the horizontal surface, the displayed value is to be of 0 m.s^{-2}. Any deviation can be rectified by manipulating the devices´ butt hinge so its measuring axis is in the closest possible horizontal position. [4]

Fig. 3. Location of XL Meter^{TM} Pro in the vehicle

System sampling rate was set to 200 Hz, i.e. we had 200 data per second available. The target process to be observed was braking with the fully applied service brake while the vehicle was equipped with ABS. The driver set the vehicle in motion to the desired speed. By activating speed limiter function we achieved the desired speed not to be exceeded. Then at the moment of the

desired steady speed the driver violently pushed the service brake pedal. Braking was being conducted until the vehicle reached zero speed.

All data were being recorded and were available in a complete file at the end of the experiment. It was necessary to stop data recording when the vehicle reached the zero speed by pushing the off button. The experiment measurement was repeated after a short break.

5. Processing of measured data

5.1. XL Vision™ Pro

All data measured by XL Meter™ Pro can be saved and evaluated later offline. Individual data are stored in the permanent memory so they are accessible even after the device is off but unly until being rewritten. The device enables 8 different measurements to be stored in its memory. It is also possible to transfer all the recorded data into PC by means of serial RS-232 cable or by standard USB cable. Communication and transfer of the measured data between a PC and the XL Meter™ Pro device and its sequential evaluation is provided by the freeware XL Vision™ Pro (Fig. 4). Data transfer is available only in the calibration mode and in the display mode at the end of the display cycle.

XL Vision™ Pro includes ever-increasing number of functions. The aim of the ever-increasing program facilities is to offer the professionals a full computer evaluation of accelerations and decelerations of different vehicles such as passenger cars, commercial vehicles, trucks, coaches, etc. The program also enables very easy documentation and archiving of measured data. Measurement results are possible to be printed in the form of measurement protocol which contains all the important data and information. [4]

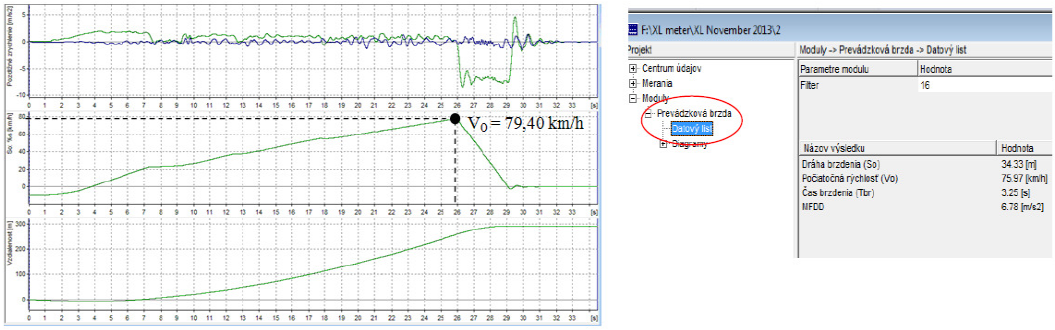

Fig. 4. SW XL Vision™ Pro

6. Evaluation and comparison of the obtained data

The following tab. 1 shows the speeds at the beginning of fully braking deceleration, calculated average values for fully braking deceleration and the data about time and distance the vehicle passed during this section, having various speeds.

Measurement no.	Obtained data				
	V [km.h^{-1}]	v [m.s^{-1}]	s [m]	b [m.s^{-2}]	t [s]
7	96.80	26.89	50.10	7.93	3.53
6	84.96	23.60	39.29	8.03	3.13
5	79.51	22.09	33.07	7.89	2.91
4	59.01	16.39	18.43	7.92	2.13
3	56.41	15.67	16.75	8.22	2.02
2	41.66	11.57	9.35	7.71	1.56
1	20.89	5.80	2.52	8.08	0.84

Tab. 1. All experiment results were obtained by XL Meter™ Pro device and processed by XL Vision™ Pro freeware

Summary of mean fully developed deceleration by XL Meter™ Pro:

Obtained values

- maximum braking deceleration XL Meter™ Pro: 8.22 m.s^{-2} (trial 3),
- minimum braking deceleration XL Meter™ Pro: 7.71 m.s^{-2} (trial 2),
- average magnitude braking deceleration XL Meter™ Pro: 7.97 m.s^{-2},
- standard deviation of braking deceleration XL Meter™ Pro: 0.149 m.s^{-2}.

Comparison of v_x – s dependence

We decided to use the „braking distance – initial speed“ dependence for the final comparison of the obtained data (Fig. 5). The red curve represents the course of the results obtained by XL Meter™ Pro. The curve is described by the regression equation. Variable *y* equals to the 2nd order polynomial regression. Variable R^2 shows the equation of the regression reliability. The value is extremely high what verifies correctness of the chosen regression type.

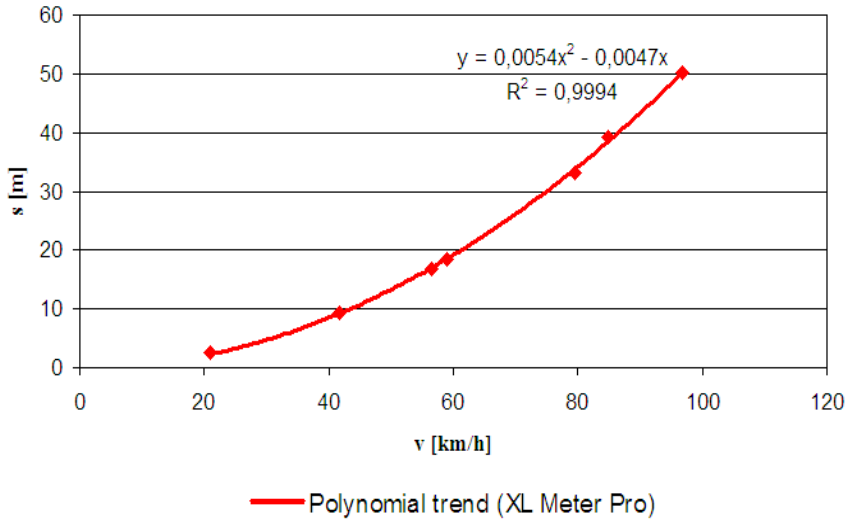

Fig. 5. Comparison of the data obtained by SW XL Vision™ Pro

7. Conclusion

The mentioned braking deceleration measurement is evaluated on seven exams. The value of density data per 1 second is 200. The use of decelerometer is user-friendlier. It is sufficient to install the measurement device in the vehicle, to calibrate it and to activate it (switch on mode) just before the drive. The device starts automatic data recording within 40 seconds. After measurements are over, it is only necessary to connect it to the PC and to obtain all the numerical and graphical data by means of XL Vision™ Pro freeware.

An important contribution of this experiment is the practical measurement of the braking behavior of the vehicle Mazda 3 MPS 2.3 MZR DISI, in particular focus on the average full braking deceleration. This value is very important for the Road Traffic Experts when elaborating the Forensic Expert's Reports of traffic accidents, where it represents the core entry value of braking behavior of the respective vehicle; or alternatively in other areas, where the measured results can help to achieve the solution.

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Rationalization of production logistics in assembly factory for electric bicycles

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Abstract. Electric bicycles in series production are assembled in various versions about fifteen years. This paper describes assembly technology in the factory with an annual production of about 25,000 electric bikes. The paper subsequently describes the divisions of assembly technology. Emphasis is placed on supply of assembly hall and sections of assembly components. Next section describes part of proposals, by which the selected sections of the assembly are rising in terms of quality or productivity. To conduct the research methods there were used analysis, summarizing observations and tabulating. Consequent implementation into practice was carried out after a general agreement with the management of the company.

Keywords: electric bicycle, assembly, quality

1. Introduction

The productivity and quality of assembly is in many companies considered as a priority pillars. As the relationship between the outcome and the time needed to achieve this result in terms of management seen as crucial to securing the services of a company operations. By assembly of the electric bicycles is divided into about 170 different operations. These operations requiring a different manual dexterity. Required time for operations is also different and therefore it is necessary to proper distribution. Prerequisite for smooth installation is timely supply of parts. Assembly of electric bicycles in the enterprise is realized in seven sections, none of which is fully automated and is more or less dependent on manual workers. Each section has its own factory foreman who organizes the work performance of workers, ensuring the maintenance department and assume responsibility for their work. In the company is 55 full-time employees, of which 42 are assembly workers. Supply sections of production are realized by warehousemen who contracting out parts specified by the production plan. Daily production is usualy from 70 to 120 pieces of electric bikes. Working time is 480 minutes with 30 minutes pause. Operation of the company runs weekdays from 6:00 a.m. to 2:30 p.m.. Ancillary works (assembly fenders, etc.) are partly implemented during overtime ended after normal working hours. At this time, it is also carried out for cleaning the hall.

Assembly process is controlled by the production plan, which is published at about 3 months in advance and the order of production series is adjusted according to actual requirements, for about two days in advance. Components are usually received from nineteen suppliers, of which nine are from China and ten from the European Union. Internal inventory management system is ellectronically. The main person responsible for the implementation of the production plan is Head of Assembly. Individual sections of the assembly receives lists of components and their required number. In addition to the frames and unsprung forks which are surface treated powder coating, the parts are ready for immediate installation. The leaders of the sections also reporting any problems to the Head of Assembly.

1.1. Warehouse of components

In this warehouse are received and sorted components from various suppliers. They are on pallets (European suppliers), containers (suppliers from China) or in holy bulk (tires). Each package of components is provided with identification informations, including code, according to stock cards in the internal software. The exact number of components is controlled only by the data on the packaging. The control system presents problems by picking components to produce, since gaps (bad codes, number of components etc.) are detected only during assembly. The resulting problems can usually necessitate a change in the plan assembly.

1.2. Paintshop

Paintshop works on the basis of electrostatic powder coating. There are finishing the surfaces of frames and unsprung forks. In one part of the paintshop is also machine for sanding of the frames and workplaces, where they are applied to electric bikes frames decorative decals. Application of colors is performed in two stages - paint application and after application of decals and clearcoat in semiautomatic cabin into which the components are conveyed on the chain conveyor. Supplying of paintshop is managed by a specific production plan, whose meaning lies in the need to minimize changes colour of powder paint. It is also necessary to supply a specified number of assembly the coated components, so as to prevent it unnecessary restrictions. Among the major shortcomings of this work include a lack of labor force skills. Due to different types of frames and forks are often applied color other than desired. Identification of frames is made by the remeasurement and comparison with the drawings. This process is lengthy and very complicated in practice paint shop operations.

1.3. Wheel assembly

In this workplace are assembling wheels and tires, including installation of the clamping mechanism. The actual string is performed on semi-automatic machines, centering is done automatically. Completed wheels are then stored on pallets and stacked. If the wheel includes engine, entangled in the front or rear wheel, these must be strunged manually. This poses problems in terms of late delivery completed wheels to the next assembly. As regards the supply of components strung, it is driven by the production plan. Tires and tubes are before assembly stored outdoors under cover. As a big disadvantage of this type of storage has been identified the possibility of degradation due to weathering and also the fact that the individual stacks of plastic is not always taken the oldest tires.

1.4. Workplace for mounting of handlebars and seats

In this section production is gradually assembled controls and safety features on the handlebars and seats. On the whole workplace is carried out with the help of hand tools.

1.5. Assembly of forks and brakes

In this section are assembled not only forks, but are fitted bottom bracket parts, brake system and electrical wiring kits. Due to various types of forks, brake systems and wires, this installation is unevenly busy. Workers in this section are involved in the production of all types of operations and balance so uneven work performance. Supplying this section is carried out on pallets.

1.6. Title, Authors, Affiliation and Headings

Completing on the line is a last part of assembly, where forcompleted components of electric bicycles are compiled into one whole. After that they are packed into boxes and prepared for storing in the warehouse. The outputs at the assembly line are uneven. Regarding the supply of

components, assembly line workers to receive them on pallets. Subsequently, each worker removes the components for his work..

1.7. Warehouse for finished products

In this warehouse therea are storing finished electric bicycles. Evidence is controlled by computer based on reports from Head od Assembly.In the warehouse are boxes with electric bicycles stored on pallets. The expedition is carried out according to release notes.

SWOT analysis of the current state

For greater clarity was created SWOT analysis, which summarizes the key points identified:

Strengths

- Assembly in one place
- Good handling and IT techonologies
- Ability to quickly communicate with all levels of operation
- Regular meetings with management
- The use of external suppliers for production and operation (option complaints etc.).
- Cooperation with development

Weaknesses

- Fast handling of complaints
- Staff qualifications (eg disadvantage. In charge of the tools and equipment)
- Organisation of assembly (eg. Underload employees - not unified overview of the tasks they can perform)
- Problems to the introduction of sandblasting and coating line

Opportunities

- Meaningful use of working time to improve productivity
- Improving the quality of production by reducing scrap and junk products assembly
- Increasing accountability for work done by individual employees - non-fulfillment of the plan assembly

Threats

- Leaving of skilled workers to better salary
- The high number of complaints (wrong company name in the market), with regards to detect errors
- Financial losses associated with the economic recession, currency fluctuations, political situation, etc.

2. Proposals for new elements in the organization of production following the analysis of the current state

In agreement with management of the company has been established that in the future will be invested into improving the logistics supply assembly components to streamline production. Analysis was created bottlenecks in the assembly, on the basis of which were selected following critical sections. Here were designed following modifications:

Organizational support for the work of all sections of assembly

For all sections of the assembly was introduced single cycle of the lists of parts, which receives each partition assembly according to plan. These lists capturing all non-standard events, as well as

the date, time of assembly of the series etc. The attachment of list of parts further signs storekeeper and the section foreman, confirming receipt of parts for assembly.

Warehouse of components

In this section have been designed and implemented rules receiving shipments, which are controlled by receipts. The boxes are checked in parts of at least one package from one entry. Further positions were created and stock inventories. For non-standard output were created forms of registration sheets. In the storage components have been designed and implemented clearer picking components for the individual sections of installation. These sections will receive the components on pallets labeled with a list of parts. The lists of parts will be after the assembly passed the following section foreman or Head of Assembly.

Wheel assembly

As already mentioned, bicycle tires and tubes are stored outdoors under cover. Due to possible degradation at prolonged storage is necessary to establish a new storage system so that they are always taken the oldest batch. This was accomplished by performing inventory, sorting and subsequent disclosure shelves with access on both sides, with the stacking occurs on one side and removing from the other side. As a long-term measure was intended to build a warehouse tires and tubes in a cool dark place.

Workplace for mounting of handlebars and seats

On this site were proposed minor changes in the form of the use of electric and pneumatic hand tools. Calculation was determined that this will achieve higher productivity. Supplying parts of this department was transformed into a partial interim storage facility, because it is a standard component. Delivered only the controls on the handlebars and seat cushions for the seat, the other parts are stored right there.

3. Conclusion

Rationalization of production logistics in a factory, engaged in assembling electric bikes, was based on the author's experience and studying of the expert literature[1][2][3][4]. Its practical implementation was preceded by extensive consultation process. In practice, labor productivity in the primary stage (immediately after implementation) increased by an average of 5%, is expected to be a further increase after the introduction of other proposals. The company management has decided to devote the saved resources to the development of other assembly technologies, which gives space for creative employees. In this context, was introduced as a bonus scheme for other suggestions, whose applications will further streamline the installation.

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The Quality Management in GMP + Supply Chain

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Abstract. An international standard GMP+ was revised from 2015 January 1st. This standard is focused on the product quality and the quality of animal feed distribution chain. The importance of monitoring the quality of animal feed has increased particularly in connection with a number of food scares when in foodstuffs of animal origin (for human table) discovered antibiotics, steroids, disease, even poisons. The standard has been tightened and unusually divided into "documents". The specific conditions for transportation, distribution and storage are prescribed.

Keywords: GMP+, feed transport, safety of feed, feed supply chain, quality of feed, distribution of feeds.

1. Introduction

Already in 1992, the Dutch feed industry has introduced rules of GMP (Good Manufacturing Practice) in response to various more or less serious cases of contamination of feed materials. Later the standard mark GMP was changed to GMP + to make theo standard in quality control of feed materials different from the same called standard in the pharmaceutical industry. GMP +, although it was first developed for the national conditions of inland practice, has become the international system, which is managed by the organization GMP + International in collaboration with various international bodies.

For standard module GMP+ Feed Safety Assurance (GMP+ FSA) fulfilling	For standard module GMP+ Feed Responsibility Assurance (GMP+ FRA) fulfilling
Feed Safety GMP+ Assurance	Feed Responsibility FRA Assurance

Fig. 1. GMP+ modules official logos (Source: www.gmpplus.org)

Currently is the standard preferentially required in the market for feed from all candidates who would like to participate in the supply of compound feed, standard conditions include the requirements for assistance on activities of transport and logistics.

In 2013 passed the standard of substantial modification where it began to emphasize the individual responsibility of the participating entities. To that reason, there were two modules created (logos, based on the current form can be designated where the requirements are fulfilled, are shown in Fig. 1):

1. GMP + Feed Safety Assurance (with regard to the management of feed safety) and
2. GMP + Feed Responsibility Assurance (focused on reliable feed).

2. GMP+ standard´s framework

Currently, the standard is extended also by in our country; it is particularly required by supply chains interested in the comprehensive quality management (TQM). GMP + is currently the complete module of standards to ensure quality throughout the supply chain of feed for livestock production.

Based on the needs of practice, more of the advanced components from the food chain, such as feed safety management system, the application of HACCP system approach, requirements management, monitoring, preparation and risk management systems, have been incorporated into the standard. The international organization also responds to reactions from participants in the GMP + standard treatment. Since the quality of the final food production is highly dependent from the compound feed and feed, this sector is constantly confronted with increased requirements for reliability and responsibility.

The current wording of the standard has undergone modifications in response to changes in the international standard ISO 9001 and is valid from 1 January 2015. Also the parts regulating logistic processes and services have undergone minor changes.

GMP+ consists of the so-called Document A - D (Table 1). By the specific requirements for the transportation, packaging, storage and distribution deals with part B.

Category	Documents
A	General treatment, logos, definitions and short circuits, dispute resolution
B	Production, trade, services, transport (road, sea, inland waterway, rail), the principle of testing requirements for the composition of feed, control and geographical notes
C	Certification bodies and assessment procedures, checklists
D	Manuals, explanatory documents, statements, minimum standards for the value of certain additives

Tab. 1. Documentation of GMP+ standard (Source: Own work on the basis of: www. gmpplus.org)

In terms of the standard the part B may be consider as the most important part, which consists of various individual standards referred to GMP + B1 - GMP + B10, annexes referred to as GMP + BA1 - GMP + BA13 and notes relating to certain localization (Table 2).

3. Current rules for the transport

3.1. Significant changes

The first change of section B.4 - Transport (Transport) is directly related to changes in ISO 9001. While the application range of this part has been often defined to ensure the quality of transport by road, waterway, sea and rail transport, and in this range include all relevant activities, including ordering, selection, acceptance of cargo space, control, administration, ...), from 1st January 2015 GMP + emphasizes inclusion in this scope of the activities carried out by third companies such as brokers or commission (also used title "co-operators"), acting as intermediaries between shippers and carriers, regardless of whether the physical transport and auxiliary processes.

The term "packaged product" cannot be understood as "packaged goods", but any product in a sealed container or enclosed cargo space, which is not the property of the carrier. The carrier is also not responsible for cleaning and filling of the cargo area. For "packaged product" shall also be concluded bags, "big bags".

Category	Document	Document title
B Standards	GMP+ B1	Production, Trade and Services
	GMP+ B1.2	Production, Trade and Services
	GMP+ B2	Production of Feed ingredients
	GMP+ B3	trade, Collection and Storage and Transhipment
	GMP+ B3.2	Trade to Livestock Farms
	GMP+ B4	Transport
	GMP+ B4.1	Road Transport
	GMP+ B4.2	Affreightment of Short Sea Shipping and Inland Waterway Transport
	GMP+ B4.3	Short Sea Shipping and Inland Waterways Transport
	GMP+ B4.4	Sea Transport Affreightment
	GMP+ B4.5	Rail Transport Affreightment
	GMP+ B6	Feed Materials Cultivation
	GMP+ B8	Production of and Trade in Pet Foods
	GMP+ B10	Laboratory testing
BA Appendices	GMP+ BA1	Specific feed safety limits
	GMP+ BA2	Control of residues
	GMP+ BA3	Minimum Requirements for Sampling and Analysis
	GMP+ BA4	Minimum Requirements for Sampling and Analysis
	GMP+ BA5	Minimum Requirements EWS (Early Warning System)
	GMP+ BA6	Minimum Requirements Labelling and Delivery
	GMP+ BA10	Minimum Requirements for Purchasing
	GMP+ BA13	Minimum Requirement for Sampling
BCN Country Notes	GMP+ BCN-CEE	central and Eastern Europe
	GMP+ BCN-CN1	Supplier Assurance for China
	GMP+ BCN-NL1	Antibiotics free feed
	GMP+ BCN-NL2	Dioxin monitoring in laying hens (rearing) feeds

Tab. 2. Documents B of GMP+ standard (updated 1st Jan 2015). (Source: Own work from www. gmpplus.org)

3.2. Conditions for road feed transport

For the road transport GMP+ currently provides the following requirements management system feed safety. The chain - in this case, the operator - to set the feed safety management system so that it is aligned with the requirements of GMP+ standard with regard to the effectiveness of continuous improvement.

3. 2. 1. Obligations of operator in the feed safety management system

The operator has to:

a) Establish and record the scope of the feed safety management system. The range must include the entire shipment for which the carrier is liable, on the basis of the following set of rules:
   1) The operator is responsible for transport.
   2) The operator must specify the entire carriage feed.
   3) The operator shall indicate all the places of business, of which operates in the safety management system of feed.
   4) The operator shall describe all other activities, which means to describe activities which do not fall within the scope of the GMP + standards and to ensure that these activities do not have to feed safety no negative impact.

5) The operator should control all transport activities falling under its own feed safety management system in accordance with the requirements of GMP+ standard. This applies to transport feed its own production and foreign production, packaged or unpackaged feed their own transportation. The standard allows the use of external operators. If the chain contractually provides services other than its own, it must ensure that the transport meets the requirements of GMP+. Within the road may thus contract only operator who is under the GMP+ certified. An exception is cases where it is exclusively the transport of packaged goods including freight containers, road when the operator is not necessarily the GMP+ certified.
6) If the road carrying plant food, subject to the special condition that the operator is certified by HACCP, such feed can be transported under the same conditions as the transport of food.

b) Create such working methods in order to perform effective transportation.
c) Make available the resources and information needed to perform carriage.
d) Monitor and evaluate the working methods.
e) Implement measures that are necessary to achieve planned results and continuous improvement of services.

3. 2. 2. Limitations of market access

These working methods must be controlled link in the chain to the requirements of GMP +.

The standard further strengthens the requirements for links in the chain, operating in one place and carry out activities covered by GMP + standard; each firm must be certified for this activity. Here it is clearly laid down very strict conditions for the penetration of the market for compound feed and feed when this system in one area may involve only the approved bodies.

3. 2. 3. Documentation

The need for documentation of the safety management system feed puts traditional emphasis on documenting according to basic standards ISO 9001, which requires the determination of policy and objectives of feed safety, documenting processes under GMP +, further has the part of chain also to submit the evidence of successful effective planning, implementation and control of traffic, records and authorization under the legislation concerning feed. The operator has to, under current arrangements GMP +, lead even further records:

a. documentation related to the transport and controls
b. the operator should have a documented system for capturing bottlenecks in the transport process and the development and implementation of quality control plan,
c. the operator must archive the results of the checks. All these documents must be kept so that it is possible to monitor the transport of feed in a short time period and, when it comes to a claim under them determine responsibility.

3. 2. 4. Staff in the transport of feed

In addition to the essential general rules according to ISO 9001 asked the personnel of operator (personnel must be professionally educated, trained, skilled and experienced, properly qualified for the transport of feed, an organizational structure that captures the responsibilities of staff have to be created and this must be available for inspection and etc.) are in the GMP+ standard for transport of feed and set specific requirements.

Staff involved in the transport must be clearly informed of their roles, responsibilities and status in written form, which must also contain instructions for cases of changes to achieve the desired product quality.

Excepting to these rules, the operator must comply with additional requirements of staff:

a) To determine the necessary knowledge and skills for personnel performing activities affecting the safety of the transport of feed,
b) To provide training or take other actions necessary for achieving of these properties,
c) To evaluate the effectiveness of the activities undertaken,
d) To ensure that its staff is aware of the importance of their activities with respect to food security and how it contributes to the achievement of the objectives in this area,
e) To maintain a record of personal education, training, knowledge and experience.

The standard does not set the exact format of the records or confirmation of the staff assessment.

3. 2. 5. Requirements for conditions of transport

The operator must ensure that the container or space:

a) is made of suitable materials that are easy to clean and prevent contamination of the feed. This condition applies in particular to surface and materials that come into direct contact with food.
b) is in good condition,
c) are suitable for this purpose and function,
d) enable the maintenance of hygiene product / process,
e) is purified from the outside, including the chassis from the visible remains of the previous cargos.

To the above requirements serves a form accompanying the cargo being carried to the breeding establishment.

4. Conclusion

Exposed food scandals in recent times have created a lot of pressure on suppliers of food of animal origin. These foods are in a great part influenced by the quality of food that animals were. Create a tightening of standards GMP+ was directed to ensure the quality of the supply chain of food of animal origin.

GMP+ standard currently has a non-traditional form of two modules, which consist of several standards. Transport and logistics activities are treated separately in specific standards.

Simultaneously, the current form of the GMP+ standard in response to changes in the international standard ISO 9001 very lightly permit the use of external services and their entry into the supply chain of transport of feed and forage. It requires that all entities have undergone complex, and let's face it even financially demanding certification. On the other hand, it provides for carriers to take precedence over other candidates for participation.

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The Validation of Transport Tickets

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Abstract. The disadvantage of transport ticket validation by carrier´s employee (usually conductor) is that this system requires higher staff costs in a comparison with the Self-Service system that puts responsibility of transport ticket validation on passenger (using marking machine itself). This contribution describes options of marking machines location in case of Self-Service system creating. One option is ticket markers placed in railway station and next option is ticket markers placed in vehicle. The methodology provides for the calculation of ticker markers in vehicles.

Keywords: Self-Service system, transport ticket validation, marking machine

1. Introduction

The transport system is a set of activities, which passenger transport is performed by [1]. At the beginning of passenger transport process the need of relocation is required. As the second it is important to become familiar with transport regulations, to find suitable connection, to buy required transport ticket and, of course, to validate it.

One form of transport ticket validation is to ensure an empowered employee by the carrier. Other form of transport ticket validation can be creating and building up the Self-Service system. To passengers, this system is well known from the urban public transport.

The disadvantage of transport ticket validation by carrier´s employee (usually conductor) is that this system requires higher staff costs in comparison with the Self-Service system that puts responsibility of transport ticket validation on passenger (using marking machine itself).

2. Self-Service System

Railway lines and vehicles with Self-Service system in use are identified by special symbol (Fig.1). The Passengers must buy transport ticket even before the boarding vehicle on. For passenger it is compulsory to validate transport ticket by marking machine as soon as possible.

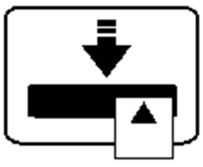

Fig. 1. – Pictogram of Self-Service system Source: [2]

If the train is equipped with the marking machine, it is required to validate transport ticket in this marker by passenger, unless it is started otherwise. Flow diagram (Fig. 2) describes the Self-Service system functionality.

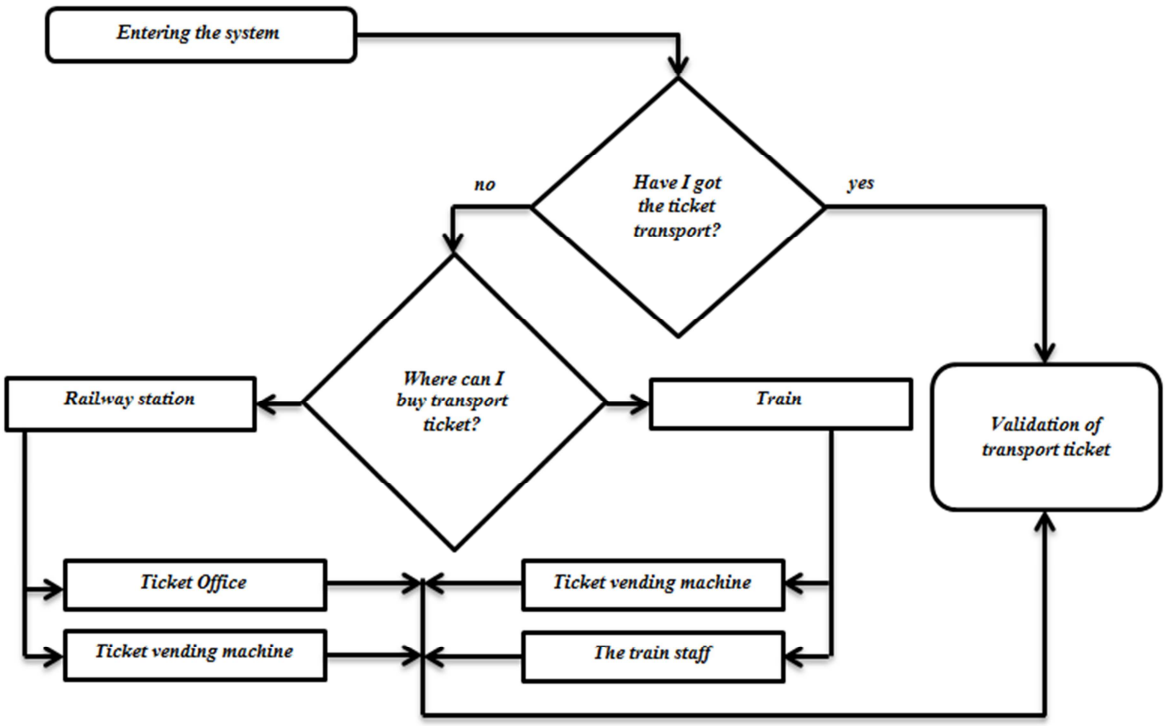

Fig 2. – The Self-Service system functionality Source: [authors]

2.1. Ticket markers placed in railway station

Train stations are places where the passengers board the vehicle (train) on or off. One of the possibilities how transport tickets to be validated is locating of marking machines in this place. Those locations are affected by various factors:

- location of station building,
- commercial distribution within the railway station (office),
- passengers flow distribution (entrances, exits, underpasses etc.),
- station tracks layout,
- platforms structural design,
- interconnection with the other urban infrastructures.

2.2. Ticket markers placed in vehicle

The most common way of markers locating is to place them into the train (vehicle). The passengers usually know this system from the urban public transport. The sum of marking machines is affected by these factors:

- type of the vehicle doors,
- train consist structure,
- number of train sets.

3. The number calculation of the ticket markers used in vehicles

3.1. Types of vehicle doors

Type of vehicle doors affect the number of used marking machines because the structure can be different depending on the transport purpose, on that the vehicle is supposed to be used for.

Technical solution of used doors can be divided:

- single door (Fig. 3 left) – simple wing with basic (standard) width,
- one and half size – simple wing (wider single doors),
- double doors (Fig. 3 right) – usually double wings with double width.

Fig. 3. – Example of vehicle doors Source: [authors]

In case of single wing door there is usually placed one of the markers where passengers can validate their transport tickets. Design of the door physically does not allow more passengers to board on at the same time, so they are in a row one by one. Technical solution of one and half size doors brings faster boarding for passengers but they still can board on only one by one, so the use (number) of markers does not change. Double wings door allow boarding of more passengers at the same time, so that it is necessary to place two markers into these doors.

3.2. The vehicle consist of train set

On the given railway line section the carrier is obligated to ensure traffic and transport performance with its vehicle under the transport service orders.

Traffic performance is determined on the basis of train-kilometers (ordering unit) [3]. The formula for its calculation is following:

$$N_{train.km} = \sum_{i=1}^{n} N_{tr_i} * L_i \quad [train.km] \tag{1}$$

where:

$N_{train.km}$	*train-kilometers,*
N_{tr_i}	*amount of trains [train],*
L_i	*travelled distance [km].*

The transport performance is determined on the basis of seat-kilometers [3]. The formula for its calculation is following:

$$N_{seat.km} = \sum_{i=1}^{n} N_{seat_i} * L_i \ \ [seat.km] \tag{2}$$

where:

$N_{seat.km}$ *seat-kilometers,*
N_{seat_i} *amount of passenger seat [seat],*
L_i *travelled distance [km].*

The proportion of these indicators determines an amount of seats in the train (train set consist). This indicator is important for resulting amount of markers. The formula for seats quantity calculation is following:

$$N_{train}^{\emptyset\ seat} = \frac{N_{seat.km}}{N_{train.km}} \ \ [seat.train^{-1}] \tag{3}$$

where:

N_{train}^{seat} *average seat in the train,*
$N_{seat.km}$ *amount of passenger seat-kilometers [seat.km],*
$N_{train.km}$ *amount of train-kilometers [train.km].*

3.3. Number of trainsets

Another factor that affect number of ticket markers in a vehicle is the number of train consists (train sets), that carrier has available to ensure traffic operation on given railway line section.

At first, it is necessary to determine the train hours that specify what is the time period of serviced activity in conditions of selected line section performance. Calculation formula is:

$$T_h = \frac{N_{train.km}}{V_o} \ \ [train.hours^{-1}] \tag{4}$$

where:

T_h *train hors*
$N_{train.km}$ *train–kilometers [train.km],*
V_o *the rate of turnover vehicles [km.h^{-1}].*

Turnover rate of railway vehicles depends on the length of line section, travel time and well time in the station. In terminal station (terminus) it is needed to calculate with an additional time of operational preparation of vehicle (cleaning, refilling of water, etc.) and the waiting time for the next performance (fig. 4).

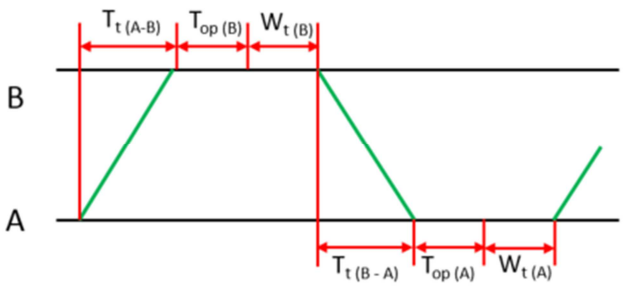

Fig 4. – The train set turnover period Source: [authors]

Formula for calculating the rate of turnover follows:

$$V_o = \frac{2 * L}{\left(t_{t(A-B)} + \left(\alpha_{r(A)} + \alpha_{z(B)}\right) + t_s + t_{op(B)} + W_{t(B)}\right) + \left(t_{t(B-A)} + \left(\alpha_{r(B)} + \alpha_{z(A)}\right) + t_s + t_{op(A)} + W_{t(A)}\right)} \quad [km.h^{-1}] \quad (5)$$

where:

L	*distance [km],*
t_t	*travel time [min],*
α_r, α_z	*margin to start and stop [min],*
t_s	*the time of stay in train station [min],*
T_{op}	*the time of operational preparation of vehicle [min],*
W_t	*the waiting time for the next performance [min].*

Turnover rate of railway vehicles can also be calculated using a traveling speed. However, in this case, the time of operational preparation of vehicle and waiting times is not considered. At the beginning of calculation it is necessary to pre-calculate proportion of travel time, cleaning time and the waiting time for the next performance. Consequently, the cruising (traveling) speed is multiplied with this factor that results in a turnover rate of train sets. The following formulas are:

$$V_c = \frac{L}{t_t + (\alpha_r + \alpha_z) + t_s} \quad [km.h^{-1}] \quad (6)$$

$$k_{TT} = \frac{t_t + t_{op} + W_t}{t_t} \quad [-] \quad (7)$$

$$V_o = V_c * \frac{1}{k_{TT}} \quad [km.h^{-1}] \quad (8)$$

The total amount of vehicles is set as the ratio of the train hours and operating time on the line section. It is very important to take in consider the reserve of value 15% in case of disturbances (disorders, reparations etc.) The formula is:

$$N_v = \frac{T_h}{t} * R \quad [total\ amount\ of\ vehicle] \quad (9)$$

where:

N_v	*total amount of vehicle,*
T_h	*train hours [train hours],*
t	*operation time [hour],*
R	*reserve [%].*

Total number of ticket marker in vehicle it is provided on the base number of vehicle (train consist structure), number of doors, coefficient doors and total amount of vehicle. The formula is:

$$N_{\emptyset\, wagon}^{\emptyset\, train} = \frac{N_{train}^{\emptyset\, seat}}{N_{wagon}^{\emptyset\, seat}} \quad [number\ of\ vehicle]$$

where:

$N_{\emptyset\, wagon}^{\emptyset\, train}$	*number of vehicle*
$N_{train}^{\emptyset\, seat}$	*average seat in the train*
$N_{wagon}^{\emptyset\, seat}$	*average seat in the wagon*

$$\boldsymbol{T_m} = \left(\frac{\frac{N_{seat.km}}{N_{train.km}}}{N_{wagon}^{\emptyset\, seat}} * \boldsymbol{N_d} * \boldsymbol{K_D} \right) * \left(\frac{\frac{N_{train.km}}{\frac{1}{v_c * K_{TT}}}}{t} * \boldsymbol{R} \right) [number\ of\ ticket\ marker]$$

where:

T_m	*number of ticket marker*	*[number],*
N_d	*number of doors in wagon*	*[number],*
K_D	*coefficient of doors*	*single door $K_D = 1$*
		one and half size $K_D = 1$
		double doors $K_D = 2$

4. Conclusion

The problematic of the ticket marker location is high-actual theme of the Self-Service system. The ticket markers should ensure quickly and comfortable ticket transport validation.

On the basis of this methodology it is possible to determine the required number of ticket markers for railway vehicles in Self-Service transport system. Numbers of ticket markers are depend on type of the vehicle doors, train consist structure, number of train.

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Analysis of Organization by Activity of Reverse Logistics

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Abstract. Article highlights the important position of services in the reverse logistics. The system is not built only on the recycling of waste as well as optimizing handling and transport operations. In this issue needs to be appropriate to adjust the deployment of entry points into the system, as well as downstream processing points, in order to streamline the system and minimize the cost.

Keywords: reverse logistic, localization, optimization, waste, efficiency of transport services

1. Introduction

Waste accompanies humanity since its inception and remains a track by successive leaves future generations. Waste arising from any human activity, in production in the consumer sector. Their formation and accumulation represents a significant intervention in the environment. Wastes containing substances that pollute all elements of the environment, ie, quality of air and soil. Penetrate into the plant via the food chain and endanger the health of animals and human populations. Slovakia, thanks to its strategic position in Central Europe and a favorable political and legislative conditions become interesting area to area foreign investors who are entering into production and trade. This trend has brought with it the need for more dealing with the logistics.

Today relevance and use of logistics can be understood as a result of international trade, coupled with the exchange of goods, services and orientation of these enterprises in the area of quality and customer satisfaction. It is a very broad scope that largely affects the living standards of the company and currently receives a large degree of attention. In the logistics planning and management is also necessary to reflect on the functioning of the reflux material and its use. The need for the deployment and operation of reverse logistics is both from an environmental perspective, since the production resources are limited and wastes constitute a significant burden on the environment, economic reasons. The use of the materials may be for companies to deliver economic and competitive advantages. Eco by involving you build a brand and thus form customer loyalty.

Reverse logistics is increasing and reinforcing trend due to the steady increase in waste production. This issue is the need to focus also because the increase recycling. I soaring internet business requires a solution of theoretical and practical problems, which covers this area.

In 2004, the Slovak Republic joined the EU and therefore in many areas we have to adapt to European legislation. However, we have the opportunity to apply the considerable funds that we can help to fulfill the requirements of EU legislation. European Union in tackling waste management has a clear policy, which is pushing for the Member States to 2020 used 50% of urban garbage produced. Currently, this value is between 6-8%. It even predicts that after 2020 the EU will want to increase the share of municipal waste. That is why it is necessary as soon as possible introduction of an optimized model, resulting in a more consistent implementation of reverse logistics activities and hence converge towards this objective.

Theory of reverse logistics is based on finding answers to basic questions about the operation of the system:

1. What systems exist, and the recovery of products, components and materials?
2. Who should carry out activities related to the recovery?
3. How can carry out these activities?
4. It is possible to implement reverse logistics activities in the classic enterprise logistics?
5. What is the efficiency and operating costs of reverse logistics from an economic and environmental point of view? What is the ratio of the performance of the system?

1.1. Reverse logistics in the context of corporate thinking

In terms of corporate thinking and planning, the entire issue of reverse logistics build on three pillars, which in principle affect the entire material flow within the waste management.

Business Planning (corporate philosophy) is the primary indicator of reverse logistics. During the planning of future product needs to be addressed questions about the future and usability of the product. Enterprise addresses the question of what material will made the product, what will be its usefulness and durability. An important aspect is how and whether they can extend the life of the product, whether due to moral and technical wear. Most manufacturing companies, however, produces their products so that their lifetime briefly exceeded the statutory warranty period. In doing so, the product structure is designed so as to avoid a simple replacement of the component. Thus, the repair of the product would be more expensive than buying a new product. They provide a way is constant demand for their production.

Material Engineering should be set to allow easy interchangeability of the parts of the product. In cases where it is not possible to go further in the operation of the product should be provided easy separation of individual components and then of separated materials that can serve as material input for further manufacturing process.

Shipping and handling - should allow to easily be able to separate out the various components of the waste without specific interventions to waste and to minimize the need for handling and sorting. The whole model should take into account the efficiency of services, ie. that optimizes the distribution of collection points and their operation, sorting and assembly points, processing and liquidation points as well as landfilling sites. It provides the ability to transport sector savings means a complete system of reverse logistics, and is also a key achievement of the goals set by the national authorities and the European Union.

1.2. Organization of reverse logistics

Repackaging and resale

These are activities that are related to repackaging which customer returned as non-use. A typical example of buying through an online store. The customer buys the goods which it is delivered by mail or courier. Because the customer is not able to physically examine the goods, has by law no. 108/2000 Coll Section 12 of the Consumer Protection Act in respect of doorstep and distance selling. Under this Act, shall be entitled to a refund of the goods within 7 working days without giving a reason. The seller shall then return his purchase value of the goods within 15 days.

Returned goods are re-distributed in specialized sale & business cases to less demanding markets. In this case, the system of reverse logistics has built marketing management and results in economic goals of the company. Our markets are not this way of handling goods widespread and offer him only a few online stores. Conservatism leads to decreased consumer demand for such products hoc their price is significantly lower compared unopened product.

Material recycling

If the goods can not be used again in the original condition, there is a rework or their removal. The material, which becomes redundant enter the recycling system. These processes have lead to a reduction in the dependence of the material production of new products. Due to resource constraints and the ever increasing price of this way of thinking is very important enterprise. It is this method of waste management can be put into practice

Organization of recovery of old products

The previous paragraph shows the need to optimize the management processes of waste management by the use of the possibility of recovery components and materials consumed goods. This includes in particular the activities of reworking, repairing eventual dismantling the subsequent use of the products. These activities require more planning and knowledge needed legislation and technical base. Therefore, this process is done by a third party using outsourcing. This method of treatment is typical for business. Their use can also ordinary consumers.

Based on the identified knowledge can be argued that the field of reverse logistics is directed mainly to the business area.

Summary of activities of reverse logistics from a strategic point of view:

- setting goals and strategies,
- The prevention reflows
- network design,
- determining the financial rules
- search for potential markets,
- assess the performance of reverse logistics.

1.3. Reverse logistics in the context of urban waste management

Another view of the reverse logistics is the management of waste within the urban management. In this species is more difficult to organize due to the fact that it is difficult to induce or encourage waste producers to engage in the waste management system. In many cases, ignorance of or low level of awareness. The result is that the majority of domestic waste is produced in the mixed container. This fact complicates the organization of optimal functioning of reverse logistics, respectively. creates unnecessary need certain operations from the processor waste. All operations should be carried out in addition, with respect to waste management costs increase both the processor technology, as well as operation. Of course, these items are then invoiced at customer service - a city or town that they reflected in the price of waste disposal (waste tax).

1.3.1. Management of waste collection

Within the overall waste management, to a company or group of urban waste collection is an important part of planning. Municipal waste management is mainly engaged in:

- the amount of waste produced,
- the composition of waste
- possibilities for waste collection,
- transport of waste
- waste recovery
- waste disposal.

Within the production and disposal of waste are the most important indicators of waste produced per capita per year, collecting network density and efficiency of the installed infrastructure. Statistically examines and composition of generated municipal waste, or the quantity of waste for selected sites. Most importantly, however, the indicator at the landfill, which defines how much waste is recovered and the number which is stored without further manipulation.

Based on the data collected, it is therefore possible to say that in our conditions, the disposal of goods primarily designed landfill, which constitutes about 74% of the municipal waste management. Treatment of waste re-use way, ie recovery of material, energy or composting forms for each area of approximately 8% of the total amount of waste. The remaining 2% of waste is disposed of by other means or incinerated. Due to whatever environment it is appropriate that separate waste incineration, without any use is only 0.2% of municipal waste produced on the territory of the Slovak Republic in 2013.

The pressure of the European Union to improve the situation in this field too. The Slovak Republic has set up a system of waste management, so that in 2020, 50% of produced municipal waste disposed of through recycling. That is less than seven years to contribute to an increase in material recovery more than 8-fold against the current value of the process. Year on year there is a reduction of municipal waste, and increase its re-use.

	2013	2012	2011
Municipal waste	1 744 4428,7	1 750 775,3	1 766 990,5
Material recovery	65 861,9	102 991,0	76 035,0
Energy recovery	173 660,3	164 093,3	181 547,6
Composting recovery	114 481,7	122 759,3	99 841,7
Recovered by other means	1 21 905,7	57 112,5	65 099,7
Landfilling	1 201 905,7	1 297 479,5	1 320 730,2
Incinerated without energy recovery		3 839,4	3 952,2
Disposed of other means	29 031,0	789,6	9 188,1
Accumulation	28 822,7	1 710,7	11 253,0

Fig.1: Production and waste management in Slovak republic

The examination is taken into account only material or energy recovery from waste and composting. There are three basic ways of handling the waste, which can be considered a full-fledged business reflux and reuse of waste. Other ways are treated as other waste, which include, for example, landfilling or incineration. As shown in Figure 10, the development of waste management is held approximately the same level. It is possible to argue that there is much room for the introduction of waste recovery at the expense of other waste management.

Within an acceptable environmental policy is pushing the European Union to its Member States to 2020 recovered 50% of the production of municipal waste. The current situation is no indication that the Slovak Republic in this period was able to meet this requirement fully optionally for the goal to even closer. For better results you need to change the system collection and waste management, as well as thinking producers of waste in the direction of environmental involvement.

The average production of municipal waste per citizen of the Slovak Republic is 323.57 kg / year, with material recovery is only 18.71 kg of waste per year. Waste production is generally

impossible to minimize (if so, only in very limited quantities). On the other hand, it is possible to encourage waste producers to implement consistent separation of waste and placing, in primary point of reverse logistics. In case of successful execution of this step could be a more efficient use of comprehensive waste management system, and realized outcomes would be much easier to read.

Indicator	The situation in SR	The situation in EU
Municipal waste [kg/people./year]	323,57	515,31
Separable waste [kg/people./year]	18,71	46,17
The rate of landfill [%]	74,11	39,87
Recovery rate [%]	24,52	38,54

Fig.2: Comparison of selected indicators of the state of waste management in Slovakia and the EU

Based on the data obtained it can be argued that most municipal waste consists of biodegradable waste. It is mainly uneaten leftovers. This waste is mostly in urban areas reprocessed. For other known commodities that make up a song household waste are the main representatives of the paper, glass and plastic.

2. Conclusion

To optimize the processes within the reverse logistics is an appropriate use of mathematical methods of quantification. Based on the experience with their help we can create an optimized process. In the case of landfilling of points is very difficult to change their location. It would be a big hit in nature and neighboring areas. However, it is possible to optimize the primary and secondary reverse points. Collecting vessels should be deployed to a distance which is proportional to the entrance (50m) to the local building reserved for such containers to prevent the image e.g. parking vehicles. However, these containers must be readily accessible to employees groupage. When deployment must take into account the possibilities to collecting waste, thus to avoid unnecessary without entering the vehicle or vehicles to have sufficient room for maneuver in space. The last criterion should be that of the impact on the continuity and security of the network. Placement secondary reverse points is also carried out on the basis of quantitative methods. The advantage of the system is that within the larger cities, it is possible to use these areas for old abandoned industrial enterprises or cooperatives broken objects. These objects tend to have connections to utilities and their use for the reconstruction not only need to build a new building. However portraits examination of the implications of such a placement in that facility and for the site (impact on the surrounding road network on the environment, but also the population).

Considering the fact that this system can not be introduced without further examination, it is appropriate to plan the location of reverse points confront and simulation model transport services tasks and optimizing the transport routes. After achieving positive results in both areas can be such a solution is considered effective and beneficial system for reverse logistics.

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Providing Public Transport Service through Competitive Tendering in the SR

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Abstract. The paper deals with procedure for procurement of public passenger transport in the SR. The first part of the paper analyses conditions of current providing public transport in the SR. Next part describes in detail individual steps that should be done in procurement process for ensuring service quality of public transport in an effective manner.

Keywords: public, transport, competitive tendering, procedure.

1. Introduction

Public passenger transport has an irreplaceable role in whole European Union (EU). It is one of the assumptions to meet basic human needs as well as for proper functioning of the national economy. Under current conditions in terms of general economic interest, the public passenger transport services cannot be always provided on a commercial basis. Therefore, the mechanisms arise by which the services in public transport are provided in order to ensure the access to basic population's needs such as work, health, and education particularly in the time of low demand. At present, the following mechanisms are used:

- the award of exclusive rights to public service operators and
- the grant of financial compensation to public service operators.

The mentioned principles are also incorporated in EU legislation – Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road. The regulation came into force in 2009 and it has brought the restrictions particularly in area of direct awarding of public service contracts. It was also adopted in order to ensure that financial support is transparent and efficient. The regulation requires the public authorities to ensure provision of public transport services in an effective manner.

Currently, the need for funding public passenger transport is constantly growing, and therefore, it is necessary to use appropriate mechanisms for award of contracts and implement proper elements into contractual relationships. The elements should motivate the public service operators to efficient and economical provision of transport services, in particular to reducing costs, increasing service quality and thereby the increasing interest in public transport from passengers' side.

The procurement process could represent a tool for achieving higher economic efficiency of the funds spent in providing public transport services. The value obtained from the funds spent includes obtaining the maximum economic, social and environmental benefits from a realized activity at the lowest possible total costs associated with planning, designing, acquisition, and operation.

2. Analysis of Current Providing Public Transport in the SR

Provision of transport services by public bus service is ordered and funded from the position of public authorities – cities or self-governing regions. Area of financing public rail transport is within the competence of state despite the efforts to transfer some competence to self-governing regions.

Majority of public authorities in the Slovak Republic (SR) has contracted with public service operators for 10 years before the Regulation came into force in 2009 (Tab. 1). This means that the Regulation will be fully applied in the SR conditions between the years 2018 – 2019. Currently, the transport serviceability in road and rail transport is provided based on the direct award of contract (usually through gross-cost contracts).

Public authority	Bus service operator	Contract duration	Reasonable profit [%]
Žilina self-governing region	SAD Žilina, a.s.	01.12.2009 – 29.11.2019	3
	SAD LIORBUS, a.s		
Prešov self-governing region	SAD Humenné, a.s.	01.04.2009 – 31.12.2018	3
	SAD Poprad, a.s.		
	Bus Karpaty spol. s.r.o.		
Banská Bystrica self-governing region	SAD Lúčenec, a.s.	01.01.2009 – 31.12.2018	koef. of inflation + 3
	SAD Zvolen, a.s.		
Nitra self-governing region	SAD Nove Zámky, a.s.	01.02.2010 – 31.12.2015	3.5
Košice self-governing region	Eurobus, a.s.	01.01.2009 – 08.12.2017	4
	SAD Michalovce, a.s.		
Bratislava self-governing region	Slovak Lines, a.s.	01.01.2009 – 31.07.2017	4

Tab. 1. Overview of public transport contracts concluded for suburban bus service in the SR**.**

According to existing contracts, the authority awards the exclusive rights to a particular operator and this enables the operator to provide public transport services. Moreover, the authority grants a financial compensation to the operator in the case that fare revenue does not cover the operator's costs. In addition to reimbursement of costs, the operator is entitled to a reasonable profit (Tab. 1). A similar system of contracts exists also in other countries of Central Europe (e.g. the Czech Republic, Hungary, and Poland).

The authorities are obligated to assume all economically justified costs calculated by operators. However, it is problematic for authorities to control eligibility of individual cost items. Under contractual relationship, the operator is entitled to the reasonable profit in addition to cost recovery. However, the determination of reasonable profit as a percentage of the costs is not economically correct procedure because such determined profit does not motivate operators to decrease their costs [4].

Public passenger services in each of eight regions of the SR are provided at level of approximately 25 million kilometres per year. This indicates that after expiration of the currently used public service contracts, the next provision of transport services will be ensured through a competitive tendering [4].

3. Process for Ensuring Public Transport

Properly concluded contractual relationship allows the creation of a strong partnership through which the authorities can pursue their policy objectives. Such a partnership should prevent from neglecting fulfilment of the tasks or abusing position of one from parties. The key factor for providing public transport services is an adequate regulatory framework and contracting conditions that should be set to support the competitive behaviour of bidders – service providers. The regulatory framework consists of three levels:

- strategic (setting basic objectives to be achieved: transport policy, public budgets, intermodality, and etc.),
- tactical (emphasis mainly on design of services and fares, requirements for staff, vehicles, additional services),
- operational (ensuring the service provision in the market according to objectives: sale activities, information for the public, deployment of vehicles, maintenance) [3].

The process of public service procurement is complex and consists of several procedural steps which must be done from authorities' position. The basis of each process should be a sufficient preparation. A good preparation can bring quality in services provided and effective use of public funds. Therefore, this part of the procurement process cannot be underestimated from the position of a public authority. In the first step, it is necessary to set the basic strategic objectives based on identified requirements of the public.

3.1. Identification of Objectives and Analysis of Local Constraints

Good service quality can be achieved through the clearly defined objectives. At strategic level, these objectives can be economic (maximize the effectiveness and efficiency of resource use in providing services), environmental (reduce the negative impacts of transport on the environment), social (ensure that all people have the opportunity of mobility regardless of their personal situation), governmental (give people the opportunity to influence the travel policy and thus to ensure responsible planning and the process of service delivery) [8].

Subsequently, the objectives should be confronted with the existing local conditions and constraints. The following local constraints should be analysed and taken into account: legal restrictions (e.g. Regulation (EC) No 1370/2007), economical constraints (public budgets), restrictions of the existing transport system (infrastructure, vehicle fleet age).

3.2. The Plan of Transport Serviceability

Processing a transport serviceability plan is the next step following the stage where public needs and strategic objectives were identified in relation to the local constraints. Optimization of transport services of a territory by public passenger transport means effective creation of the offer of transport performance in public passenger transport, especially in terms of satisfying the transportation needs of people living in the served area by effective spending of public resources.

Preparation of the plan of transport serviceability should be the first step of public authorities in the process of ensuring transport services in the case of the direct award of contract as well as competitive tendering. Plans of transport serviceability should include: list of lines (routes) or their parts on which it is intended to perform public transport in general interest, frequency of links, requirements for a reasonable scope of services, method of solving concurrent transport, and etc. [5].

After processing the transport serviceability plan, public authorities must decide on scope of public service contracts they want to conclude, and they should estimate the value of transport services to be provided.

In terms of the scope of the contract, the public authority can decide on:

- route contracts – used for a specific bus line or can include a group of shorter bus lines located close to each other,
- network contracts – these contracts cover whole city territory and network of city public transport or they are related to more transport modes such as metro, bus, and tram,
- sub-network contracts – related only to a certain part of city (e.g. suburb of city) and only one mode of transport [9].

3.3. Deciding on Procedure of Awarding

When deciding on procedure of awarding, Regulation (EC) No 1370/2007 must be taken into account. Direct award of public service contract is only possible when the average annual value of the services provided is estimated to be less than 1 000 000 € or services in relation with public interest are provided in the range of less than 300 000 km per year. The limit of 1 000 000 € increases up to 2 000 000 € per year and the limit of 300 000 km increases up to 600 000 km in the case of direct award of public service contract to small or medium-sized enterprise that does not operate more than 23 vehicles. Otherwise, a competitive tendering must be employed. Basic

principles in procurement are non-discrimination, proportionality, transparency and equal treatment. For both cases (direct award and competitive tendering), a preliminary information notice must be published in Official Journal of EU at least one year before beginning of awarding procedure.

3.4. Evaluation Criteria and Qualifying Conditions

The submitted bids can be evaluated based on the lowest price or the economically most advantageous bid. To deliver higher quality in services the criterion of the economically most advantageous bid appears to be more suitable.

Public authorities must determine the evaluation criteria which reflect the expectations that is to be achieved through public transport services. The evaluation criteria can be distinguished in terms of type and kind. Individual types and kinds of evaluation criteria with stated examples are presented in Tab. 4.

Types of evaluation criteria	Kinds of evaluation criteria	Examples
quantitative	*cost*	the lowest offer price
		repairs and maintenance
		operating costs
		return on investment
	utility	technical level
		technical parameters
		environmental impact
	time	interchanges
		continuity
		travel time
qualitative	*quality*	safety and comfort

Tab. 2. Types and kinds of evaluation criteria**.**

In order to determine to what extent the feature of quality is fulfilled, it is necessary to find a way to measure particular feature of quality. Transformation of qualitative criteria into quantitative criteria is performed due to the measurability of quantitative criteria. The intensity of quality can be measured, for example, by using ten-point scale. Interval of scoring is compiled from the unsatisfactory quality up to the perfectly satisfactory quality.

Besides evaluation criteria, it is also necessary to determine qualifying conditions that tenderers must meet and demonstrate in order to participate in a competitive tendering. They can be asked to demonstrate their financial and economic status, prove a quality certificate, and etc.

3.5. Drafting a Public Service Contract

Basically, the forms of individual contracts differ in an allocation of risks between contractual parties and the resulting structure of payments. The contract forms are as follows:

- management contract, where an operator bears no risk; cost and revenue risk are borne by an authority,
- gross cost contract, where an operator bears cost risk; the risk from difference between anticipated and actual costs in the end of period and an authority bears the risk from difference between anticipated and actual revenue
- net cost contract, where an operator bears cost and revenue risk. In this case the operator bears the risk from difference between anticipated and actual costs/revenue, which are identified in the end of contract period. The authority pays only compensation which is agreed before realized performance to the operator. This means that the authority bears no risk [4].

Certain flexibility should be also incorporated in contracts because of changes in external factors, political aims or passenger needs. It is necessary to note that the longer the contract period, the more increases the need for flexibility of the contract. It is necessary to note that determined qualifying conditions for tenderers, evaluation method of bids as well as the framework service contract should be included in tender documentation. After documentation is completed, the authority can publish notice of tender and call for bids.

3.6. Evaluation Process of Bids

First of all, the qualifying conditions of tenderers are assessed. In case that some of tenderers does not meet the mentioned conditions, he is asked to supplement the missing information, otherwise he can be excluded from competition.

Only bids that were submitted by the deadline for submission of bids can be evaluated, otherwise they are excluded from competitive tendering. For evaluation of the bids, a contracting authority (public authority) compiles an evaluation committee. Committee members must have professional education and practice corresponding to the subject of the contract. Contracting authority may also appoint additional members to the committee, but without the right to evaluate bids, in order to ensure transparency. The results of tender must be published and also must sent the successful tenderer as well as all unsuccessful tenderers.

3.7. Monitoring during the Contract Period

The award of the contract cannot be the last step of public authorities in public service provision. Control of compliance with obligations can be done through the use of self-fulfilling contractual features such as incentives or by monitoring systems (classical control of services provided).

Incentives can be used to utilise the profit maximising aims of operators to achieve the policy aims of the authority instead of just writing down rules and prohibitions into the contract, as these need to be thoroughly monitored by the authority to be effective. They might be used to compensate for reduced or difficult monitoring to create self-fulfilling contractual features. They are an instrument to secure the quality level [9].

4. Conclusion

The need for funding public passenger transport is constantly growing. Therefore, it is necessary to implement proper elements into contractual relationships. The Regulation (EC) 1370/2007 have brought the changes mainly in area of direct awarding of contracts in providing transport services. Competitive tendering appears as an appropriate mechanism, the introduction of which brought cost savings. Thanks to the cost savings it might be possible to release funds for the provision of any additional services or expanding the area of interest. The process of public service procurement is very complex and consists of several procedural steps. The basis of each process should be sufficient preparation. Only good preparation can bring quality in services provided and effective use of public funds. Preparation of procurement process cannot be underestimated from the position of public authorities, because a properly concluded contractual relationship can prevent from neglecting fulfilment of the tasks or abusing position of one from parties.

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Analysis of Energy Loss in the Propulsion System in Terms of Identification of Energy Saving Potential

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Abstract. Ship Energy Efficiency Management Plan (SEEMP) is a part of Annex VI of the MARPOL Convention. The requirement has been applicable to all ships (both new and existing ones) of 400 gross tonnage or above commencing on January 1st, 2013. The plan is intended to be a practical measure supporting ship-owners and crew in the management of vessel environmental performance. However, the main goal of SEEMP is to improve ship operational efficiency. It means the reduction of fuel consumption, maintenance costs and emission volume, reducing the total cost of operation. The implementation of SEEMP is not obligatory for small vessels. However, energy audits, being a part of SEEMP, provide fishermen with possibilities in the scope of energy efficiency improvement for their vessels. The article presents analysis of energy loss in the propulsion system in terms of identification of energy saving potential letters.

Keywords: fishing vessels, modernization of fishing cutters, energy saving

1. Introduction

Ship Energy Efficiency Management Plan (SEEMP) is a part of Annex VI of the MARPOL Convention. The requirement has been applicable to all ships (both new and existing ones) of 400 gross tonnage or above commencing on January 1st, 2013. SEEMP should be onboard of every ship. The Polish small fishing vessels, operating from the ports located on the Polish coast, constitute a numerous group of 881 registered, active vessels. The craft varies in age and, with an average service of 29 years, they are one of the oldest fleets on the Baltic Sea[5]. The vessels, also varying in size and technological standards, have one of the lowest power ratios among the fishing vessels operating on the Baltic Sea. The technical condition of vessels and power ratio to a large degree affect fuel consumption, one of the main elements used in assessing their economic effectiveness and environmental impact[1].

2. Energy loss

Usually four-stroke self-ignition engines are used in the ship propulsion system. They are relatively low effective energy machines. Their efficiency does not exceed 45%. Due to a number of losses occurring in the entire propulsion system, only 10-15% of the chemical energy provided in fuel is transferred into useful energy for vessel propelling, which is presented in fig. 2. The remaining energy is the loss of the engine, gear, shaft line, hull and the propeller. Due to the specific structures of a propulsion systems for fishing vessels, certain losses may be omitted in the process of energy efficiency assessment because of their small share in total losses, while high investment costs are essential in order to their further reduction [1].

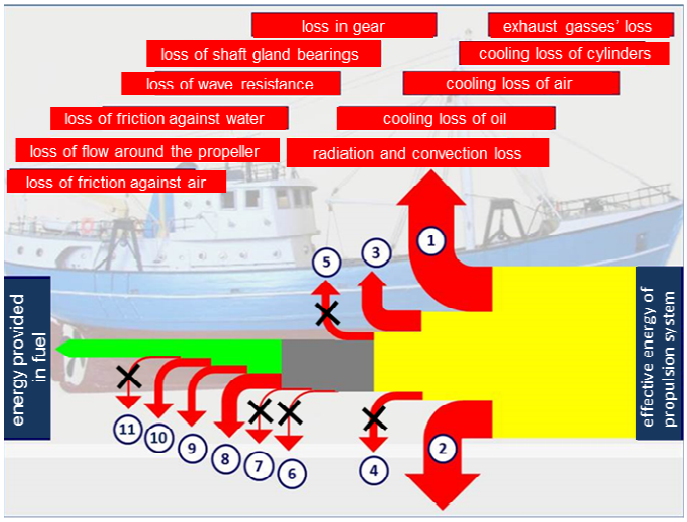

Fig. 1. Elements of propulsion system losses presented in the Sankey diagram indicated for use in modernized energy audit sheets (based on [3]).

The results of the audits carried out for the main propulsion system of the selected vessels' group indicate the desirability of seeking the solutions in terms of propulsion system loss reduction by the means of:

- the loss reduction of wave resistance by improving the underwater hull's structure;
- the loss reduction in the engines and gears of the propulsion system;
- the loss reduction of flow around the propeller
- heat recovery from exhaust gases and cooling the engine cylinders (1 and 2 in fig. 2)

The results of this part of the audit presented in figure 3, regarding the hull technical condition maintenance, show that the most of the vessels obtained around 60 out of 100 possible points. The result points to good technical condition and virtually to the lack non-investment opportunities to reduce energy losses in the areas related with the improvement of hull technical condition. Energy consumption may be significantly reduced by hull structure modernisation. The solutionisrelated with high investment costs.

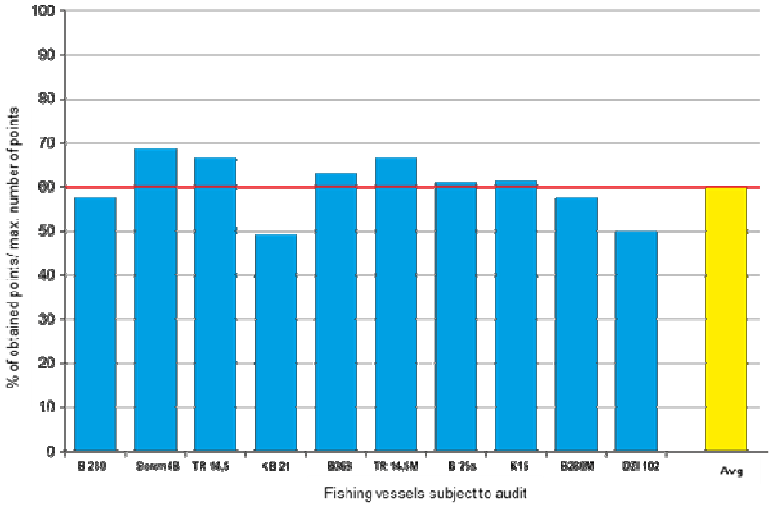

Fig. 2. Technical condition assessment for the hull based on the audit results.

The highest rating was obtained for the propeller technical condition. The average rating was 78 out of 100 points possible to obtain for ten vessels subject to the audit (Figure. 4). It is a result of both the complex propulsion system modernisation, including the propeller, and the fact that fishermen understood and appreciated that the propeller technical conditions affects the fuel consumption. In most cases, the propellers had the blades optimized to the fishing gear used and

were polished, and the propeller technical condition was assessed as very good. Practically, there is no possibility to improve the energy efficiency without investing in that area.

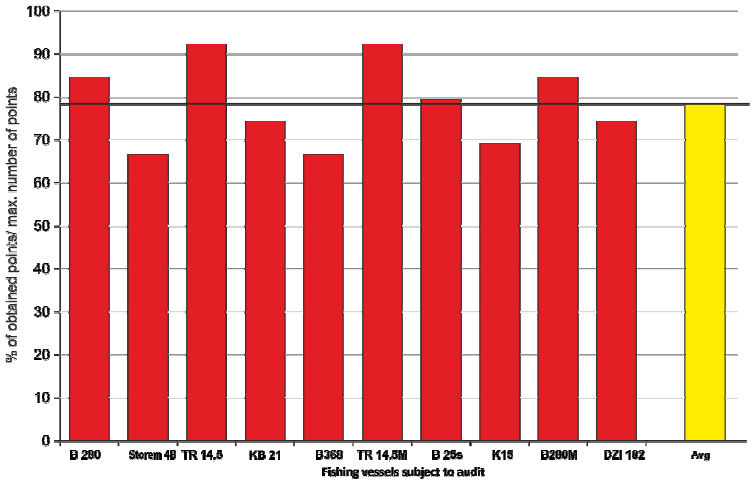

Fig. 3. Propeller technical condition assessment based on the energy audit results

The improvement in the scope of the propeller may be obtained only by implementing propeller structural amendments. However, this is related with high investment costs to be incurred. A practical assessment of the existing propulsion system should consist in a development of standard characteristics for relative fuel consumption per a unit of distance traveled in the speed function :

$$gs = f(v). \tag{1}$$

where:

g_s - fuel consumption per a unit of distance traveled [l/Mm].

The characteristics may be developed on the grounds of fuel consumption measurement, during free sailing and trawling, using mobile devices fixed for further research on the propulsion system. The characteristics of the relative fuel consumption per a distance unit allow for making a decision on the selection of optimal sailing speed. Modern engines with the electronic control system of fuel injection are equipped, as a standard, in temporary and hourly fuel consumption meters. Coupling them with navigational devices, which provide particular signals on the vessel speed and distance traveled, require low financial investments, and allow for the current control of fuel efficiency changes related with the technical condition or replacement of fishing gear. The comparison of the current fuel characteristics with the standard one, developed for the best technical condition, allows for detecting problems affecting the vessel energy efficiency. An increase of fuel consumption per a distance unit usually indicates that the technical condition and the surface quality of the hull and the propeller should be controlled [4].

One of the main goals of the engine useful load analysis and economical aspects arising therefrom in the form of fuel consumption is to determine the most appropriate selection of a propulsion system engine to the conditions in which it is operated.

The data from the vessels, gathered for the purpose of the energy audit, served for preparing a useful load analysis of the engines which were designed for a specific task.

For the purpose of the paper, the data creating a set applied for the analysis was defined and registered. It includes the following values:

Sw- the relative pitch propeller; a ratio of operational pitch propeller value to nominal pitch propeller expressed as a percentage,

hw- the relative position of the fuel link; a ratio of operational shift of the fuel link, corresponding to the operational fuel doze to the shift corresponding to the fuel dose for nominal power, expressed as a percentage,

Pel-the power of shaft generator
Pelp- the relative power of shaft generator, the power expressed as a ratio of operational power to its nominal power.
Bv- average fuel consumption by the main engine, measured by a volumetric flow meter

The data was registered during operating a ship and covers: pitch propeller, location of the fuel link, the power of shaft generator and fuel consumption. Out of the above number of samples, a part was selected. It covered the following operational states: sea voyage and trawling. Thus, loads of the propulsion system may be treated over a longer period of time as constant, and then the sample of propulsion system load, related thereto, may be deemed as satisfactory and representative for the time period.

The respective research methodology is in compliance with the IMO requirements (Annex IV of Marpol Convention 73/78), which is based on the requirements of ISO 8178. The measurements covered the specific operational states of the fishing vessels:
- Stay at a port.
- Free sailing (to fishing areas).
- Maneuvering (port, roadstead, providing and gathering of trawls).
- Trawling.

The route of B-25 vessel during the measurements is presented in figure 1 on which the route to fishing areas and a diagram of speed measured in relation to the sea bottom are shown.

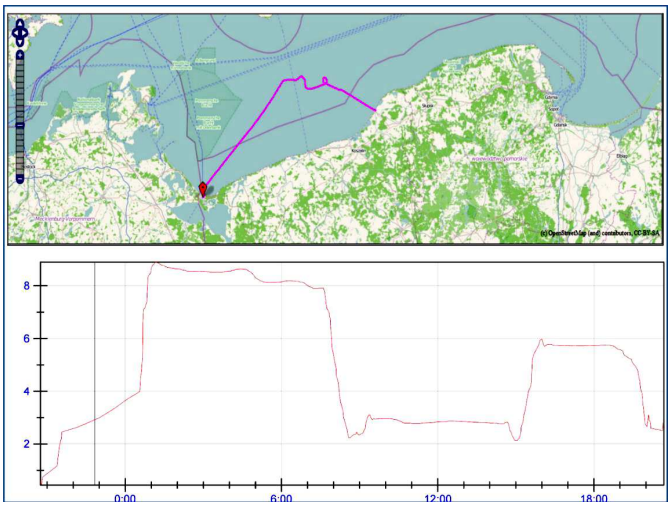

Fig. 4. . Vessel route and travel speed during operational measurements (carried out on the grounds of [2])

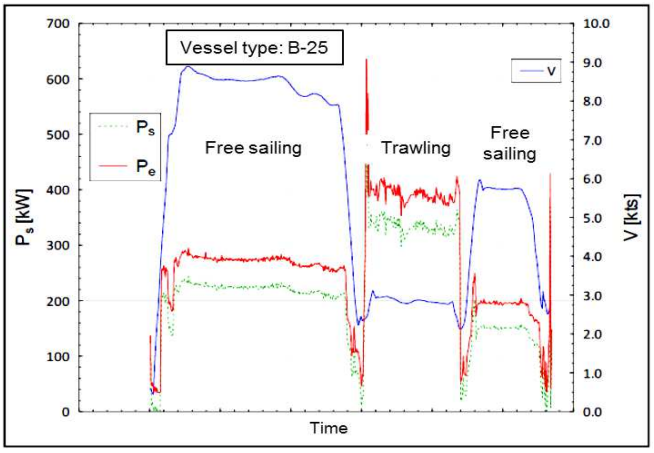

Fig. 5. . Registered course of value changes of propulsion power and useful power of main engine referred to the vessel speed (based on [2])

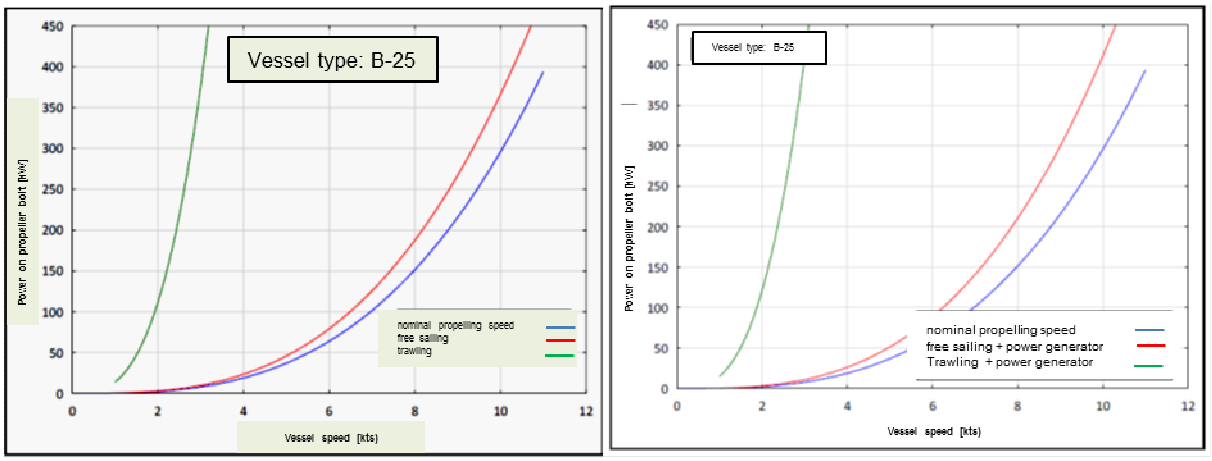

Fig. 6. . Propulsion characteristics for free sailing and trawling. (based on [2])

The data collected during the energy audit indicates that there is a possibility to reduce energy losses in the area of the improvement of the main engine and gear technical condition (figure 9) among the others by organisational activities assessing the propulsion system energy efficiency during a normal operation of the vessel. In order to do so it is essential to monitor fuel consumption and engine power. The monitoring should be connected with the optimisation function.

3. Conclusion

A current analysis of the measurement of relative fuel consumption and a distance traveled allow for making decisions aimed at the reduction of the relative fuel consumption per a route unit up to 10% as correctly used measure of fuel consumption:

- supports decisions related with the change or modification of operational customs affecting fuel consumption
- provides information on the impact of ballast change and operational trim on the vessel energy efficiency
- provides information on the impact of change of fishing gear on the vessel energy efficiency
- provides information on the impact of hull fouling and weather conditions on the vessel energy efficiency.

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The Vehicle Parameters in Different Traffic Conditions

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Abstract. The number of people who reside and work in Kielce areas increases. A spatial growth of suburbs settlements lead to an increase in the need for mobility. More and more people are choosing to move their own cars and consequently more vehicles occupying the city streets. A lower traffic flow is especially evident in the mornings and afternoons hours, which are so-called peak hours. The aim of the paper is to show the differences in driving in peak hours and between peak hours.
Keywords: congestion, peak hours,

1. Introduction

Plenty of people decide to move their own cars, valuing their own convenience and comfort. This resulted increasing number of passenger cars in the cities during peak hour. Kielce is a medium-sized city, so the congestion phenomenon is observed mainly on the entry streets (eg. Sandomierska Str., Tarnowska Str., Krakowska Str., Łódzka Str.) and a city center (eg. Ogrodowa Str., Seminaryjska Str., Żytnia Str.). The drivers should take into account the lower traffic flow and possibility to spend more time in their cars.

The typical driving in city conditions consists of a complicated series of accelerations, decelerations and frequent stops. It leads to serious implications for emissions and fuel consumption. During the start-up phase the motor needs more power to accelerate the vehicle than during driving with a constant speed. The power is needed to overcome the track resistance and to increase the kinetic energy of the vehicle. In consequence the emissions and fuel consumption increase.

The aim of this article is to investigate vehicle parameters and fuel consumption while driving along selected streets of the city during peak hours and between peak hours.

2. Experiment procedure

The test route includes the entrance street and the city center (Fig. 1). This overall distance is equal to 18,8 km for the urban area. The route was passed five times at different parts of the day:

1. mornings peak hours at 7:25,
2. midday hours at 11:10,
3. afternoon at 14:07,
4. begin of afternoons peak hours at 15:09,
5. afternoon peak hours at 16:05.

The route led through the streets of various traffic density. The test was conducted by the entry streets and the city center, where the congestion was formed.

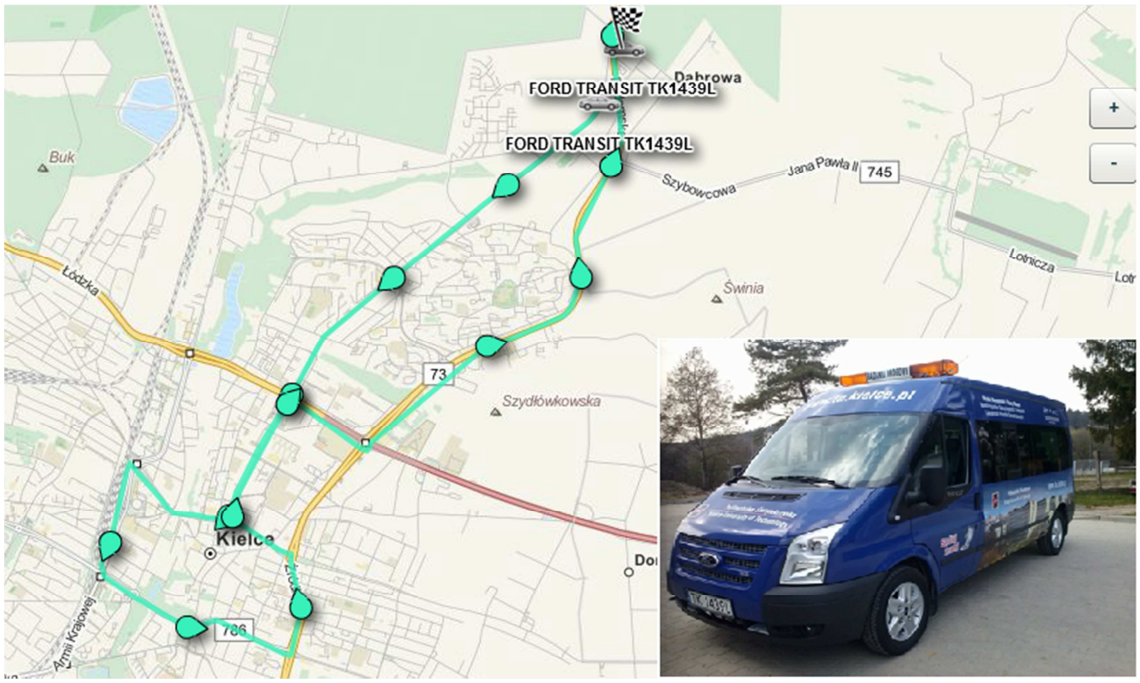


Fig. 1. Trajectory of movement and the test vehicle

The test vehicle was Ford Transit F6 (Fig.1.) equipped with:

- CDS- GPS Data Logger – lightweight data logger for various vehicle dynamics testing applications by Kistler® (Fig. 2),
- vehicle tracking and fleet management system by Globtrak®.

Fig. 2. GPS data logger with accessories

The measurement equipment allowed analyzing the different driving conditions in the prescribed city districts, including:

- average velocity of vehicle,
- longitudinal acceleration,
- travelled distance,
- movement trajectory of the vehicle, including position (latitude and longitude) and height above sea level,
- fuel consumption.

3. Verification

The time in which the testing route had been travelled was shown in Tab. 1. The time was measured by the Globtrack system and a stopwatch. The travelled time were different for different times of a day. The first passage (at morning peak hours) took the least time. The longest passage of the same route was extend for almost 10 minutes (about 30% longer). As had been noted during the tests, the peak hours were not significantly affected by the rate of movement of vehicles in the city center.

Passage	Time	distance, km	average velocity, km/h
1	37’47’’	18.78	29,82
2	44’34’’	18.84	25,36
3	40’55’’	17.96	26,34
4	51’50’’	18.68	21,62
5	48’40’’	19.01	23,44

Tab. 1. The parameters obtained during passages

Basing on the observations one could assumed that the congestion mainly slowed down traffic on the entry streets of the city. The traffic decomposed similarly at streets in the city center. A value of average speed at the measuring distance was recorded by the GPS Globtrak® system and was presented at a Fig. 3. The values of average speed were different for various part of a day. The lowest average velocity were recorded during the fourth and fifth passages. It was caused by increase of traffic during the afternoon peak hours.

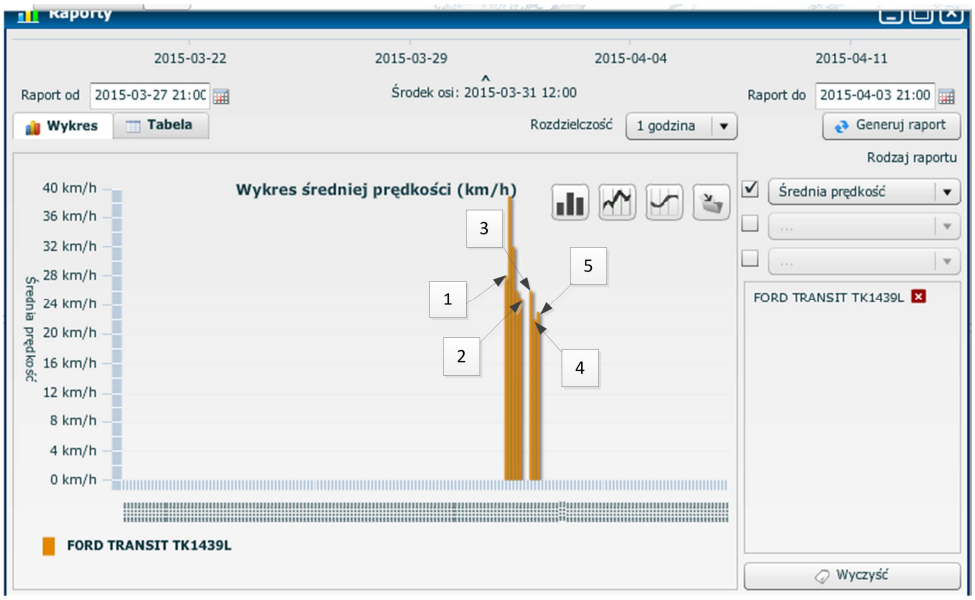


Fig. 3. The value of the average velocity recorded by Globtrak® system

The important vehicle performance parameter was fuel consumption. Fig. 4 presents the amount of fuel consumed during each passage and a level of fuel in test vehicle’s tank. As it can be observed, the travel time and the amount of fuel consumption undergo considerable variations.

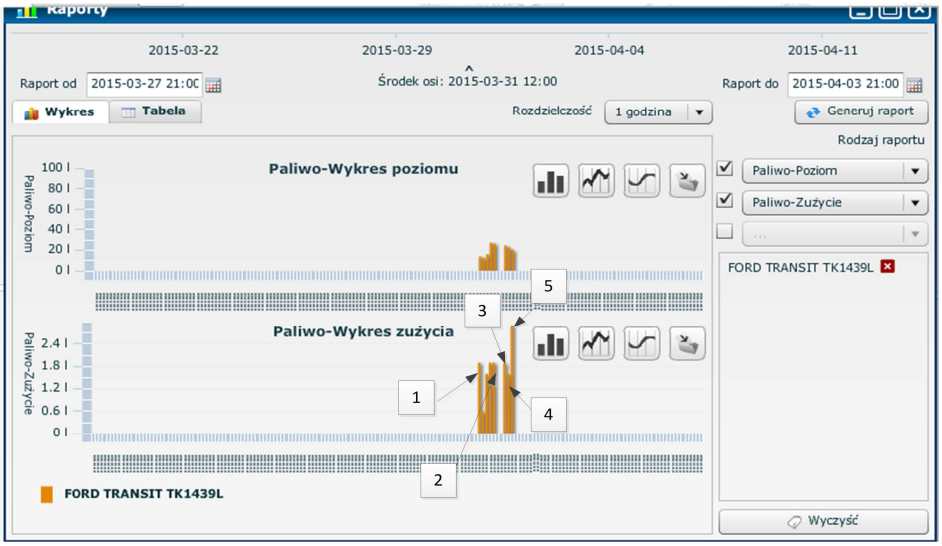


Fig. 4. The fuel consumption during the passage

Passages marked on the Fig. 5. as 1st, 2nd and 3rd caused fuel consumption on the 1.9 dm^3 level, which corresponded approximately 10.1 dm^3 per 100km. It was the surprise that during the 4th passage value of fuel consumption decreased to 1.6 dm^3 (8.5 dm^3 per 100km). During this passage the lowest average velocity was also recorded. The fifth passage took the longest time and occurred the highest fuel consumption – 2.9 dm^3, which gave nearly 15.2 dm^3 per 100km.

The terrain in Kielce is formed by a number of hills. The estimate terrain elevation above sea level is 271 meters. A difference in altitude between the highest and the lowest point along the test route was 75 m. A driver should be prepared for long steep climbs and long descents.

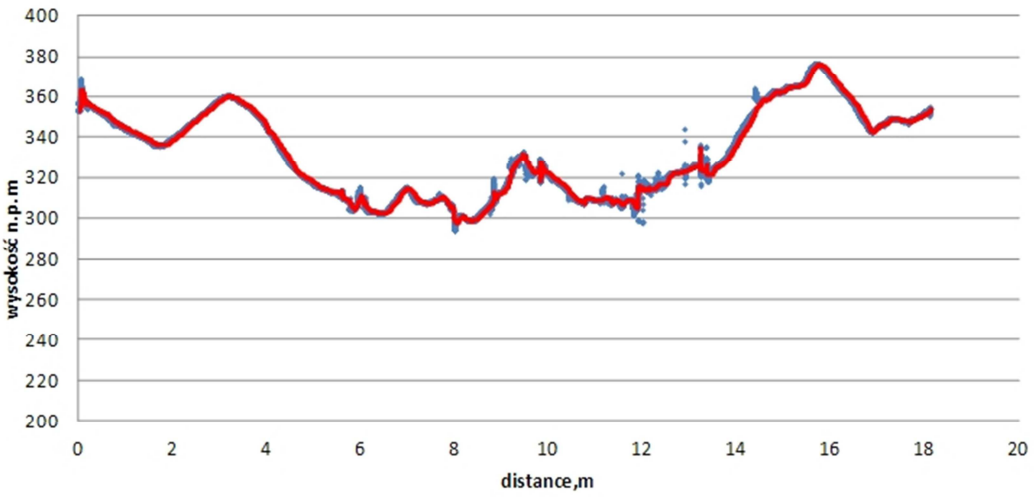
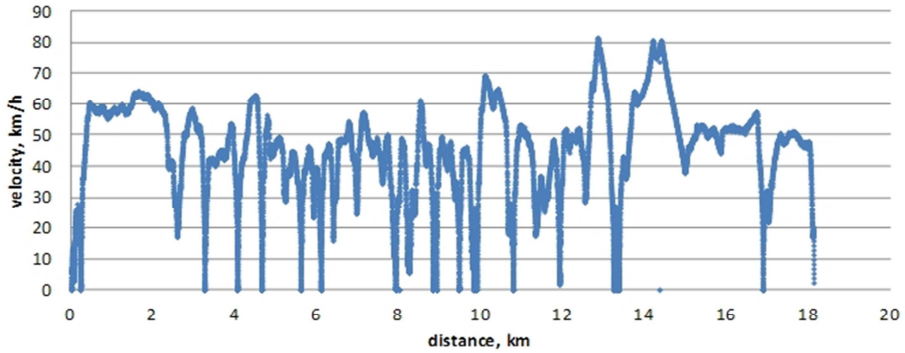


Fig. 5. The altitude of testing route measured by CDS-Data Logger

Fig. 6 presents velocity logs for all passages. During the 1st, 2nd and 3rd passages a number of the vehicle deceleration to stops was accordingly 17, 21 and 19 times. The time of the stops (when the vehicle was not moving) was respectively: 11.35, 10.09 and 13.07 minutes during the whole passage. This may prove relatively similar driving styles and lower traffic flow. During the 4th and 5th passages the car stopped 32 and 30 times. The vehicle was not moving for 17.53 min during the 4th passage and 22.42 min during the 5th passage. This was caused by the afternoon peak hours.
During all passages some series of frequent and successive stops repeating in the area 8-13 kilometers were observed. This area included the city center, the Żelazna Str., Żytnia Str., Ogrodowa Str., Seminaryjska Str., Źródłowa Str. and Tysiąclecia P.P. Avenue.

1



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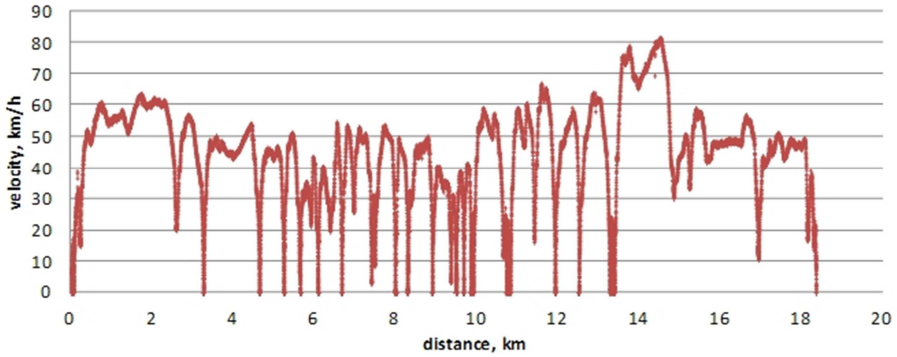

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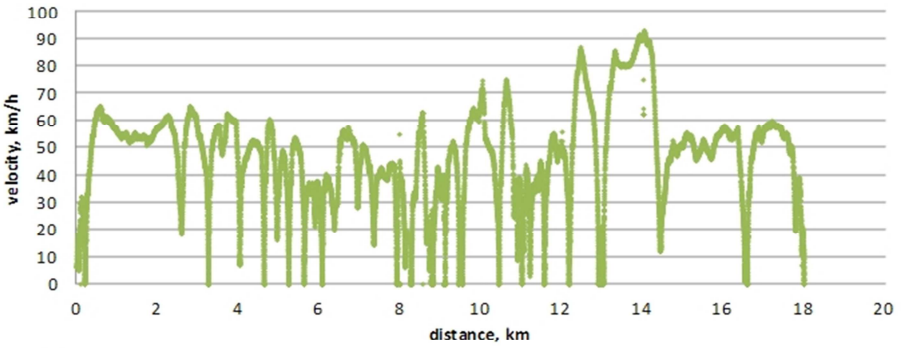

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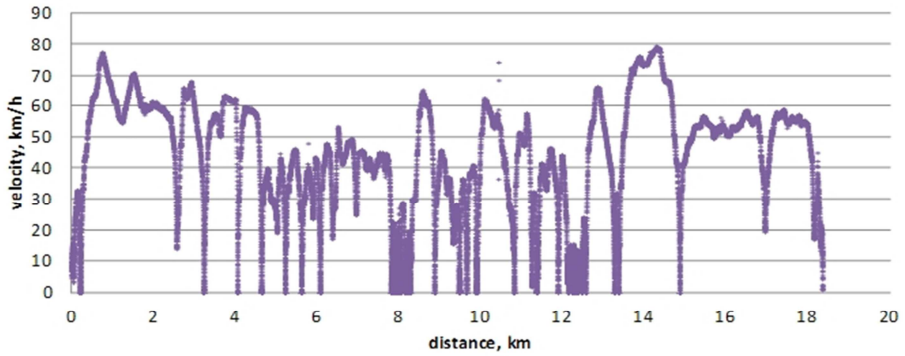

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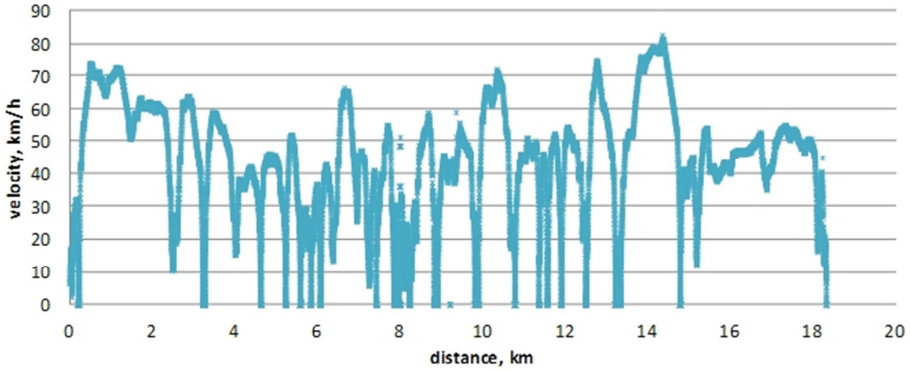

Fig. 6. The velocities measured by CDS-Data Logger during passages

4. Conclusions

The modernization of city infrastructure in Kielce has brought expected results. The travelled time measured was different for various part of a day. A difference between driving at midday and during peak hours was estimated on the 30% level. Our investigation confirmed, that traffic jams formed mainly in the city center. The series of frequent and successive stops, which repeated during all passages were observed in this area.

The researches allows us to explore the prevailing traffic conditions in Kielce and introduction to further studies. The next step of our work is to create a driving cycle for the Kielce and consideration of implementing the alternative propulsion in public transport vehicles.

Acknowledgement

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The Quality Impacts on the Performance in Freight Road Transport Sector

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Abstract. The paper deals with the problem of service quality, quantification of the quality and evaluation of service quality in freight road transport companies. In the paper will be also exanimated the relation between performance indicators and quality (QMS) in freight road transport.
Keywords: Quality, performance, road, transport, evaluation

1. Introduction

The level of criteria impact on service quality will be expressed. The growth of the quality level affects behaviour of customers and can stimulate their demand for service, which in turn promotes the growth performance and competitiveness.

Implementation of the EN ISO 9000 defined as a set of quality standards that are determined as being necessary for manufacturers and service organizations to be effective competitors can be used by management of the companies to improve performance and higher quality output.

Quality Management System (QMS) by STN EN ISO 9 000 series should be a guarantee of quality. The QMS specifies the requirements for quality management system in companies. The QMS specifies the requirements for quality management system in companies which want to and need to show ability to provide products in accordance with the relevant regulations and requirements of customers. Basic requirement: implement, document and maintain the quality management system and continually improve it.

More about benefits of implementing QMS is defined in publication [3].

2. Transport KPIs

There are many different KPIs that can be used to measure the performance in a freight transport operation and it can be difficult to know which ones might be right for enterprises. A KPI should be relevant and SMART - Specific, Measurable, Achievable, Realistic and Timed, as well.

KPIs should be specific, simple to use and easy to understand. Complicated statistics and formulae can lead to the confusion and uncertainty about what is actually being measured in the first place. If KPIs are specific and kept simple, they can be easily communicated across the business and there is no need for staff to have an in-depth knowledge of the area being measured.

KPIs can show changes in performance over time. For this to happen, it is inevitable to compare like-with-like data.

The size, type and management structure of a company is likely to influence the range and type of KPIs that might be used. KPIs can be used to help managers develop strategy, plan and make decisions, while at the operational level they can show clearly the areas that need improvement, or a change in approach [2].

The transport KPIs are designed to be relevant and appropriate to small and medium – sized operations and focus on the most important aspects of the vehicle operation. The transport KPIs cover six core areas:

- costs,
- operational,
- service,
- compliance,
- maintenance,
- environmental.

There were found three studies abroad that estimated KPIs in freight transport area. The KPIs were compared and made intersection of all the KPIs. The transport KPIs were used for examination of the quality impact on the performance in freight road transport.

3. QMS Impact on the Performance in Freight Road Transport

For purpose of examination of QMS impact on the performance in freight road transport was created questionnaire. Objective of the survey was to determine an effect of QMS on performance indicators but also to determine the time which is necessary to see a QMS impact.

The effect of QMS was measured with Likert scale. Likert scale is able very easy way to express and measure opinion of respondents. Likert scale assumes that the strength / intensity of experience is linear, i.e. on a continuum from strongly agree to strongly disagree, and makes the assumption that attitudes can be measured. Respondents may be offered a choice of five to seven or even nine pre - coded responses with the neutral point being neither agree nor disagree.

The Likert scale is used to allow the individual to express how much they agree or disagree with a particular statement. [8]

The questionnaire is divided to the following parts:

- general information about company,
- structural indicators,
- operational indicators,
- indicators of quality and service,
- economic indicators,
- indicators of effectiveness and time.

The questionnaire was sent to companies which have certificate EN ISO 9001. Based on ERRU, association of road transport operators of the Slovak Republic (ČESMAD) and European databank more than 3 000 companies of road transport was checked. The results showed that only 31 companies have QMS and only half of them have certificate EN ISO 9001.

The survey was attended in total 33 organizations:

- 6 micro companies (up to 19 employees),
- 2 small companies (from 20 up to 49 employees),
- 22 medium company (from 50 up to 249 employees),
- 1 big company (more than 250 employees).

3.1. The Effect of QMS on Performance Indicators

The performance indicators were measured by Likert scale that means it is needed to transfer the scale to numbers (table 1).

Likert scale	The range of Likert scale	
	From	Up to
Very significant decrease	-3	-2,51
Significant decrease	-2,5	-1,51

Slight decrease	-1,5	-0,51
No change	-0,5	0,49
Slight increase	0,5	1,49
Significant increase	1,5	2,49
Very significant increase	2,5	3

Tab. 1. The range of Likert scale

Indicators		Value	Transfer	State	Likert scale
Indicators of customers		**0,55**	**0,55**	**Positive**	**Slight increase**
1	number of new customers from abroad	0,8	0,8	Positive	Slight increase
2	Number of orders from abroad	0,6	0,6	Positive	Slight increase
3	number of new customers from domestic country	0,5	0,5	Positive	Slight increase
4	Number of orders from domestic country	0,3	0,3	Positive	No chance
Operational and performance indicators		**0,02**	**0,46**	**Positive**	**No chance**
5	Transport Performance [tons/ km]	0,89	0,89	Positive	No chance
6	Total number of km run by your fleet	0,44	0,44	Positive	No chance
7	Number of transportation with payload / total number of transportation	0,33	0,33	Positive	No chance
8	Percentage average vehicle fill	0	0	Positive	No chance
9	Average fuel efficiency	-0,33	0,33	Positive	No chance
10	Total empty run	-0,33	0,33	Positive	No chance
11	Percentage empty running total	-0,89	0,89	Positive	Slight decrease
Costs indicators		**0,04**	**0,19**	**Negative**	**No chance**
12	Average driver cost	0,38	0,38	Negative	No chance
13	Average standing cost	0,25	0,25	Negative	No chance
14	Average cost of removing faults	0,17	0,17	Negative	No chance
15	Average running cost	0	0	Negative	No chance
16	Average costs per unit delivered	-0,25	0,25	Positive	No chance
17	Average cost of fees	-0,25	0,25	Positive	No chance
Indicators of fulfillment of the legislation		**-0,85**	**-0,85**	**Positive**	**Slight decrease**
18	Total number of overloads	-0,38	-0,38	Positive	No chance
19	Total number of vehicle traffic infringements	-0,75	-0,75	Positive	Slight decrease
20	Total number of traffic accidents	-1	-1	Positive	Slight decrease
21	Improper fixation of load	-1	-1	Positive	Slight decrease
22	Number of infringements of social legislation	-1,13	-1,13	Positive	Slight decrease
Maintenance indicators		**-0,43**	**-0,43**	**Positive**	**No chance**
23	Percentage of failed or overdue safety inspections for you fleet [%]	-0,43	-0,43	Positive	No chance
Quality indicators		**0**	**0,37**	**Positive**	**No chance**

24	Number of satisfied customers	0,44	0,44	Positive	No chance
25	Timeliness	0,33	0,33	Positive	No chance
26	Safeness of work	0,33	0,33	Positive	No chance
27	Simpler / clearer documentation	0	0	Positive	No chance
28	Number of damages on transported goods	-0,33	0,33	Positive	No chance
29	Number of complaints	-0,78	0,78	Positive	Slight decrease

Tab. 2. The results of survey in road transport companies

For better imagination of the performance indicators, there is a figure 1. In the figure are shown all performance indicators that were measured.

The performance indicators that increased are shown above major axis and the performance indicators that decreased are shown under major axis.

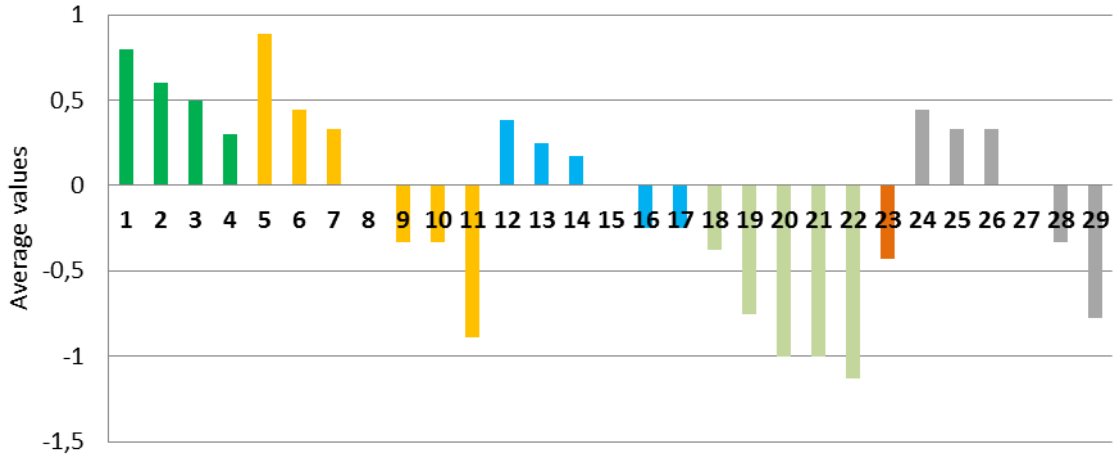

Fig. 1. Average values of the performance indicators

The largest decline was recorded in the variable "number of infringements of social legislation", while the largest increase occurred in the variable "transport performance".

Almost all the indicators where was expected decrease, the decrease were occurred. The increase was only in the average standing cost and average running cost. The increase in costs can be linked with the cost of introducing QMS and its maintenance.

Almost all the indicators where was expected increase, the increase were occurred. The increase was not only in the “percentage average vehicle fill and simpler / clearer documentation”.

At the end of the questionnaire was question: “Was the introduction of the QMS a benefit for your company?” The result of the question is shown in the figure 2.

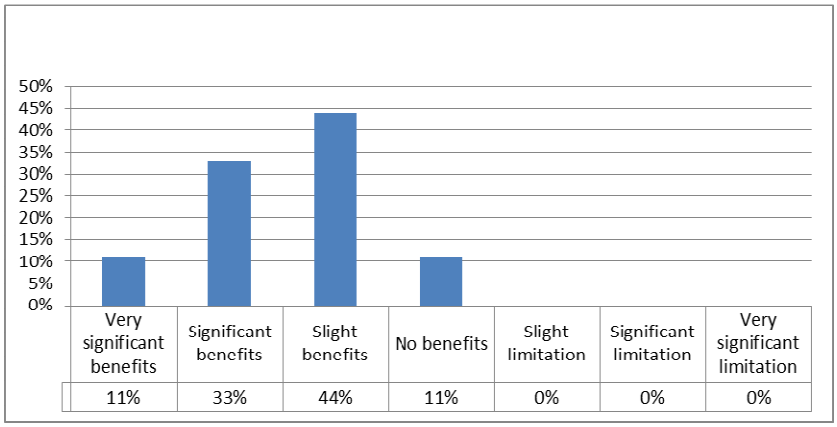

Fig. 2. Benefits from QMS in transport companies

The average value of the QMS benefit is 1,5 that is significant benefit. It can be said that QMS implementation has a positive effect in companies.

4. Conclusion

The article confirmed that there exists an impact of QMS on performance in company. It can be said that QMS has a positive effect at road transport companies. In the example was shown which indicators are affected by QMS the most. The QMS has the greatest effect on Indicators of fulfillment of the legislation and the weakest effect on cost indicators.

The quality management system did not have any bad impact on the performance indicators. Based on this fact quality management system by EN ISO 9001 can be recommended to the road transport companies.

Acknowledgement

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The Influence of Beginning of Railway Routes of Periodic Timetable Introduced into the Line 031 in the Section Pardubice hl. n. – Hradec Králové hl. n. upon the Rail Capacity

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Abstract. This article deals with the influence of periodic railway timetable introduction upon the line capacity. The line selected was the line 031 between two regional centers, Pardubice and Hradec Králové, where the implementation of the periodic timetable makes sense. The simulation program SimuT, operating with the double-track line between the stations Stéblová - Opatovice nad Labem – Pohřebačka, was used for solution. Some capacity indicators were counted, based on the regulation SŽDC (ČD) D24. Consequently some interesting conclusions were chosen and are presented in this article.

Keywords. Capacity, interstation section, periodic timetable, railway routes.

1. Introduction

The influence of periodic railway timetable introduced upon the line capacity is one of difficult problems to solve for capacity optimization. Exactly defined routes of periodic timetable (PTT) cause difficulties due to crossing on single track lines as same as overtaking on double track lines.

2. Infrastructure and the Method of Calculation

At the beginning, the infrastructure must be defined as well as the method of calculation must be explained.

2.1. Infrastructure

There are 5 stations and 4 block sections on the line 031 in the section Pardubice hl. n. – Hradec Králové hl. n. The stations are Pardubice hlavní nádraží, Pardubice - Rosice nad Labem, Stéblová, Opatovice nad Labem - Pohřebačka and Hradec Králové hlavní nádraží. Between the stations Stéblová and Opatovice nad Labem - Pohřebačka the double track line with the line speed 160 kph (now under construction) is being reconstructed, between other stations there is only an old single railway line with the line speed 100 kph maximum.

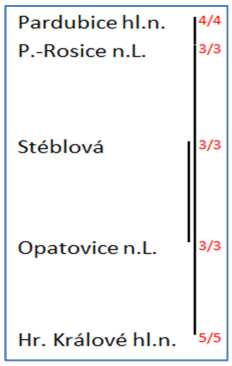

Fig. 1. The scheme of the line 031

2.2. Method of Calculation

In this simulation, there are three types of trains operated on the infrastructure in the PTT. Regional trains (RT), which stop in every station on the route, fast trains (FT) and regional expresses (RE), which stop only in three stations – in Pardubice hlavní nádraží, Pardubice – Rosice nad Labem (due to the connection with the line 238) and Hradec Králové hlavní nádraží. The difference between the fast train and the regional express is the travelling time and the destinations. Regional expresses terminate in regional centers - Pardubice and Hradec Králové and their travelling time is less. The fast trains continue to the third regional center - Liberec (line 030). The trains travelling times are displayed in the Tab. 1 and Tab. 2.

Railway station	Type of train					
	RT		RE		FT	
	A	D	A	D	A	D
Pardubice hl. n.		X. 00		X. 20		X. 40
Pardubice – Rosice n. L.	X. 03	X. 04	X. 23	X. 24	X. 43	X. 45
Stéblová	X. 12	X. 13		X. 30		X. 51
Opatovice n. L. – Pohřebačka	X. 20	X. 21		X. 36		X. 57
Hradec Králové hl. n.	X. 27		X. 43		(X+1). 04	
Total traveling time	27 min		23 min		24 min	

Tab. 1. Train routing of the PTT Pardubice hl. n. - Hradec Králové hl. n.

Railway station	Type of train					
	RT		RE		FT	
	A	D	A	D	A	D
Hradec Králové hl. n.		X. 00		X. 20		X. 40
Opatovice n. L. - Pohřebačka	X. 04	X. 05		X. 24		X. 46
Stéblová	X. 12	X. 13		X. 30		X. 53
Pardubice - Rosice n. L.	X. 20	X. 21	X. 36	X. 37	X. 58	X. 59
Pardubice hl. n.	X. 24		X. 40		(X+1). 02	
Total traveling time	24 min		20 min		22 min	

Tab. 2. Train routing of the PTT Hradec Králové hl. n. - Pardubice hl. n.

The program SimuT [1] was used for the calculation. A PTT with the period 20 min from 5 am to 9 pm. was created, containing in total 96 trains in 960 min. To make it easy, freight trains were eliminated. However, between the stations Pardubice hl. n. and Pardubice - Rosice nad Labem there are some operated trains, which then continue on the line 238 in the direction of Chrudim and Havlíčkův Brod. In this common interstation section, the occupation of the track by these trains must be taken into account. The number of these trains was taken from the 2014 timetable, 32 trains in total, 16 in each direction (from 5 am to 9 pm.) [2].

Individual routes of PTT were moved with a step of 5 min, e g. the beginning of RT routes then were X.00, X. 05, X. 10, X. 15. This move was applied on both directions – in total 16 variants then had to be solved. The step of X. 20 and more weren't solved – the route of RT was similar to the route of RE within this period.

The difference of beginning of railway routes from both directions is especially important. During the simulation there was found that capacity indicators are the same for variant X. 00, X. 00 and variant X. 05, X. 05. The capacity indicators are the same for every variant with the same difference of beginning of railway routes from each direction. It is then enough to count 7 basic variants. In each of the following tables there are displayed the interstation section, number of track (TK), amount of trains (N) and then capacity indicators T_{occ}, t_{occ}, D_o and $\Delta\overline{D_{AG}}$. These capacity indicators are based on the regulation SŽDC (ČD) D24 [3]. T_{occ} means total time of occupation of an interstation section, t_{occ} average time of occupation, D_o means degree of occupation of railway equipment. $\Delta\overline{D_{AG}}$ is total average delay increment, calculated as the share of difference of delay on

output and input of the system and the number of trains. In program SimuT there was set a random input delay of trains based on exponential distribution of probability. For each variant 365 runs of simulation were carried out - for each day of the timetable.

3. Variants of Beginning of Railway Routes of Periodic Timetable

Seven basic tables with different routes are displayed here - Tab. 3 - 9.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	376,0	2,94	0,39	
Pardubice – Rosice n. L. – Stéblová	1	96	699,5	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	1,86 min/train
Stéblová – Opatovice n. L. – Pohřebačka	2	48	157,5	3,28	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	553,7	5,77	0,58	

Tab. 3. Capacity indicators – simulation screenplay X. 00, X. 00.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	373,1	2,91	0,39	
Pardubice – Rosice n. L. – Stéblová	1	96	699,5	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	0,92 min/train
Stéblová – Opatovice n. L. – Pohřebačka	2	48	157,5	3,28	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	559,5	5,83	0,58	

Tab. 4. Capacity indicators – simulation screenplay X. 00, X. 05.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	373,1	2,91	0,39	
Pardubice – Rosice n. L. – Stéblová	1	96	699,5	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	1,30 min/train
Stéblová – Opatovice n. L. – Pohřebačka	2	48	157,5	3,28	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	559,5	5,83	0,58	

Tab. 5. Capacity indicators – simulation screenplay X. 00, X. 10.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	373,1	2,91	0,39	
Pardubice – Rosice n. L. – Stéblová	1	96	700,1	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	167,4	3,49	0,17	2,28 min/train
Stéblová – Opatovice n. L. – Pohřebačka	2	48	157,5	3,28	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	551,5	5,74	0,57	

Tab. 6. Capacity indicators – simulation screenplay X. 00, X. 15.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	379,0	2,96	0,39	
Pardubice – Rosice n. L. – Stéblová	1	96	707,5	7,37	0,74	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	2,17 min/train
Stéblová – Opatovice n. L. – Pohřebačka	2	48	157,5	3,28	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	553,7	5,77	0,58	

Tab. 7. Capacity indicators – simulation screenplay X. 05, X. 00.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	379,0	2,96	0,39	1,60 min/train
Pardubice – Rosice n. L. – Stéblová	1	96	699,5	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	
Stéblová – Opatovice n. L. – Pohřebačka	2	48	154,2	3,21	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	547,8	5,71	0,57	

Tab. 8. Capacity indicators – simulation screenplay X. 10, X. 00.

Interstation section	TK	N	T_{occ} (min)	T_{occ} (min)	D_o	$\Delta\overline{D_{AG}}$
Pardubice hl. n. – Pardubice – Rosice n. L.	1	128	379,0	2,96	0,39	1,10 min/train
Pardubice – Rosice n. L. – Stéblová	1	96	699,5	7,29	0,73	
Stéblová – Opatovice n. L. – Pohřebačka	1	48	171,0	3,56	0,18	
Stéblová – Opatovice n. L. – Pohřebačka	2	48	154,2	3,21	0,16	
Opatovice n. L. – Pohřebačka – Hradec Králové hl. n.	1	96	547,8	5,71	0,57	

Tab. 9. Capacity indicators – simulation screenplay X. 15, X. 00.

Values of capacity indicators are the same or similar in the tables - capacity indicators were counted for range 5 am - 9 pm and with the move of the beginning of the railway route some routes exceeded the 9 pm. The total average delay increment $\Delta\overline{D_{AG}}$ is distinctly different for each table. The least, it means the best, is the capacity indicator for the variant X. 00, X. 05 (0,92 min/train), then for the variant X. 15, X. 00 (1,10 min/train) and then, on the third place, for the variant X. 00, X. 10 (1,30 min/train). The worst is the capacity indicator for the variant X. 00, X. 15 (2,28 min/train). The difference between the worst and the best variant is 1,36 min/train, that means in the amount of 128 trains totally 174,08 min, it means almost 3 hours (of delay). This demonstrates the routing is for efficient use of PTT very important.

4. Conclusion

The beginning of railway routes in terms of PTT really influences the amount of capacity, especially on single railway lines. In this specific case, on the line 031 in the section Pardubice hl. n. - Hradec Králové hl. n., the best variant (the least total average delay increment $\Delta\overline{D_{AG}}$) is the variant with the routing + 5 min from Hradec Králové hl. n., it means variants X. 00, X. 05; X. 05, X. 10 or X. 10, X. 15.

The influence of beginning of railway routes in terms of PTT upon the rail capacity is possible to find out for more lines, but in the case of use of integrated periodic timetable the problem cause different optimal beginnings of routes for particular lines. In this case it must be found the optimum for whole railway network and some solutions only for one line could be abandoned.

Acknowledgement

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Finding the Optimal Location of Postal Processing Centers on Existing Railway Infrastructure

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Abstract. National postal operators are usually obliged to provide services at certain quality to all citizens regardless the generated costs. Therefore they need to find a way to lower the costs by modifying their activities. One option is to optimize the transport network. The article focuses on creation of postal transport network based on existing railway infrastructure in the Slovak republic. The research approach adopted in this article relies on methods of graph theory to solve problems of locating facilities. The p-median allocation model is applied on underlying network infrastructure, which abstracts the existing railway connections between relevant cities. Findings of this research represents only basic solution for optimization, which is affected by input values. More thorough analysis of infrastructure need to be performed in order to improve the solution.

Keywords: Optimization. P-median. Infrastructure. Postal network

1. Introduction

The main business activity of postal operator is reliable and regular delivery of postal items. Customer demands the guaranteed delivery time while postal operators (such as any other business entities) seek to maintain this parameter at minimal costs. Apart from the processing technology, transport itself is a critical factor for time and cost. It is affected by the location of postal facilities and connections among them [1]. The number and location of postal processing centers in the postal transport network is determined mainly by logistical functions of the entire postal system. The decision how many highest level nodes and where to locate them can be considered as strategic. Therefore it needs to be made based on the results of the optimization process.

2. Allocation models for network optimizing

The graph theory is widely used in optimization of transport networks. It enables to describe and to abstract these networks and formulate different tasks to solve [2]. One of these tasks is finding the optimal location of facilities. Very helpful in this case are the *allocation models*. The role of such mathematical models is to find answers to key questions. We need to decide how many facilities to locate, their locations and how many demands to be covered by individual facility [3]. Allocation problems differ in type of objective function (calculating the sub-optimal output value) and model of the environment in which they are addressed. In our case, the model of environment is the transport network abstracted into a complete weighted graph $G = (V, E, c, w)$. V is the set of nodes (vertices) representing possible facility locations. E is the set of edges representing connections between nodes. Label $c(e)$ of edge $e \in E$ is its value (length, time distance, etc.). Weight $w(v)$ of node $v \in V$ represents the importance of node in solved system [4].

To find the location of postal transport network centers, it is convenient to use discrete network allocation models. One of the basic parameters for solving problems of such type is the very

distance between nodes. From this point of view, it is possible to subdivide allocation models into two categories – models based on maximum distance and models based on average distance [5]

Models based on the average (or covering) distance seem to be the most appropriate for issue addressed in this article. When locating facilities, these models do not take into account the maximum distance between the facility and demand node, but consider the total/average distance between the facilities and all demands. They ensure that the average distance between any node and facility location will be minimum possible [5]. We decided to use the p-median allocation model.

2.1. P-median allocation model

The objective of this model is to find location of *P* number of facilities in the network, ensuring to cover all of demands and the average transport costs to be minimal [6]. These costs can be determined by multiplying the demands of network node and the distance between a node and the closest facility serving its demands. P-median model works with the following variables [3]:

Input variables:

I – set of nodes with demands to be served,

J – set of candidate nodes for facility location,

h_i – demand at node i,

d_{ij} – distance between demand node i and candidate node j,

P – number of facilities to locate.

Decision variables:

X_j – has the value 1, if we locate facility at candidate node j; has the value 0, if not

Y_{ij} – has the value 1, if demands at node i are served by facility at node j; has the value 0, if not

The p-median problem can be formulated as follows:

To minimize:
$$\sum_{i=1}^{n}\sum_{j=1}^{m} h_i d_{ij} Y_{ij} \tag{1}$$

Subject to:
$$\sum_{j=1}^{m} Y_{ij} = 1 \qquad \forall i \in I \tag{2}$$

$$\sum_{j=1}^{m} X_j = P \tag{3}$$

$$Y_{ij} \le X_j \qquad \forall i \in I, j \in J \tag{4}$$

$$X_j, Y_{ij} \in \{0,1\} \qquad \forall i \in I, j \in J \tag{5}$$

The objective function (1) minimizes the total demand-weighted distance between each demand node and the nearest facility. Constraint (2) requires each demand node i to be assigned to exactly one facility j. Constraint (3) states that exactly P facilities are to be located. Constraint (4) states that demands at node i can only be assigned to a facility at location j if a facility is located at node j. Constraints (5) are standard integrality conditions [3].

The basic and simplest heuristic algorithm for solving the p-median allocation problem is *myopic algorithm*. It belongs to a group of construction algorithms, which involves finding an initial solution by successive selection of optimal locations for 1-median problem. The improvement algorithms are built upon construction algorithms. Their goal is to find the optimal or sub-optimal location for facility. This group includes neighborhood search algorithm and exchange algorithm [5]. Since the myopic algorithm finds the very first appropriate solution and does not try to optimize it, we use the *neighborhood search algorithm* (Fig. 1).

3. Allocation of postal facilities on railway network

The knowledge of the environment is essential to be able to design and create the postal network; especially its demographic and geographic parameters or administrative subdivisions. The

most important is the underlying infrastructure. Used type of transport in the postal sector depends entirely on the nature of postal items and transportation requirements. Is also influenced by the level of development of infrastructure, potentially useable for postal item transportation in each country. [7]

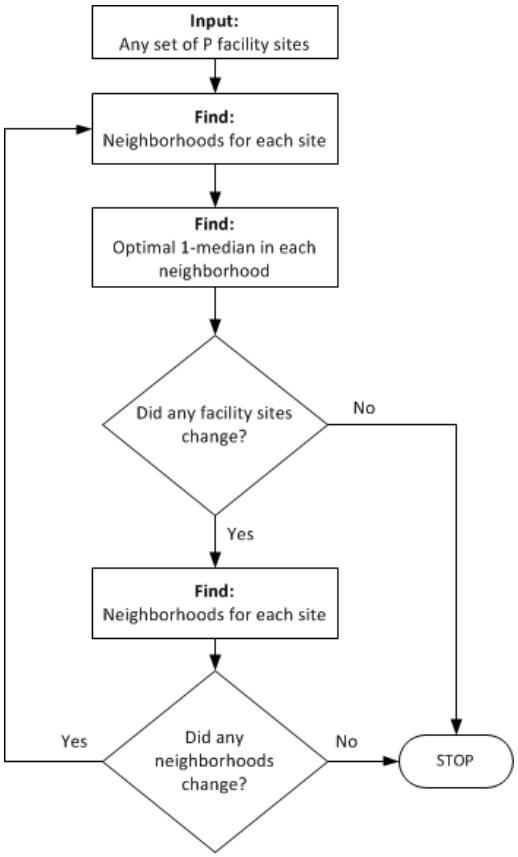

Fig. 1. Neighborhood search algorithm [3]

3.1. Underlying network

We are dealing with the idea of creating a new network, based on the existing transport infrastructure. The basic model of the environment is complete weighted graph $G = (V, H, c, w)$. The graph is built upon the basic territory administrative division of the Slovak Republic to the districts. The Slovak Republic is divided into 79 districts. This number was reduced by merging city districts of largest cities, since they have one administrative center. Nodes are placed in the administrative centers of districts – district towns. The resulting number of vertices is 71. They were placed to the blank map of Slovakia in order to maintain the similarity with their exact geographic location. The population of each district represents the number of demands to serve, and thus determines the weight of the node.

Next step is to determine the set of edges and their weight for a graph representing railway infrastructure. To find the existing railway connections and its lengths we used the software solution for the calculation of charges for the use of railway infrastructure. All existing lines were taken into account, regardless to used traction and quality category of the lines. We found out, that some nodes are pendant, since there is no existing railway connection to the rest of the network. Diagram of created graph is in the figure below (Fig. 2).

3.2. Application of p-median allocation model on railway infrastructure

After analysis and abstracting of existing infrastructure into a graph, it is necessary to determine the optimal location of highest level postal processing centers. Random selection on large networks would be difficult and inaccurate, therefore the allocation model is used to solve this

issue. Although there are known algorithms for optimal results, in complex networks it is time-consuming and complex computing solution. To obtain results faster, we used the software created by Professor Mark S. Daskin called *SITATION*.

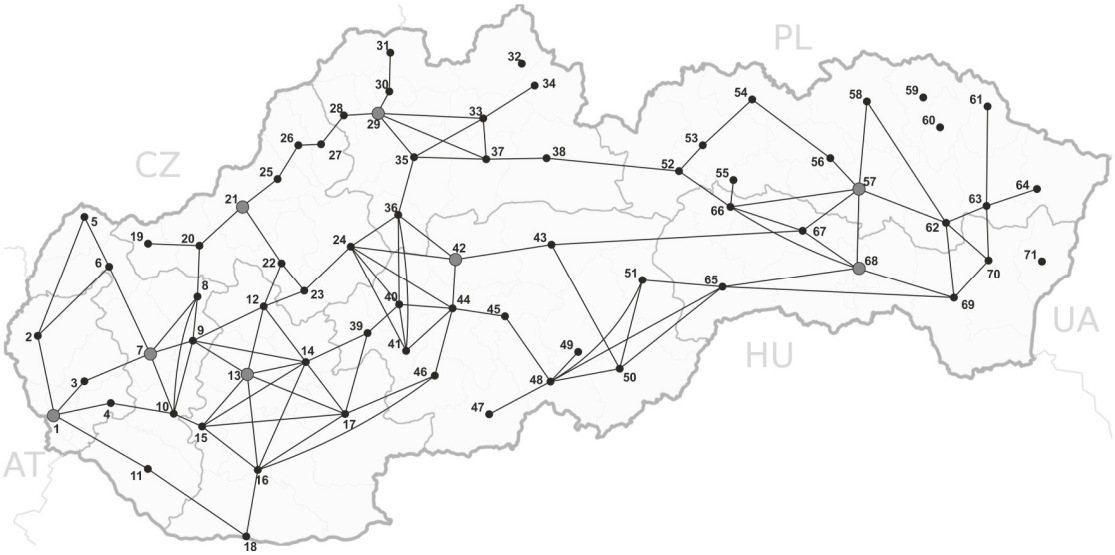

Fig. 2. Underlying graph representing the railway infrastructure in the Slovak republic (Authors).

In order to use p-median allocation model, other parameters need to be identified. Important is a variable describing the coverage of demand by given node – the covering distance. Its value reflects the maximum distance required for the transport of postal items from superior node (facility we want to locate) to subordinate node and vice versa. Due to the size of Slovakia and the results of the infrastructure analysis we determined the covering distance of 100, 150 and 200 km. Since we discovered that some nodes are not connected to the network, we decided to assign the requirements of such nodes to the nearest road connected nodes, which belong to the railway network. We assume that demands of not connected nodes would be served by nearest nodes via transshipment from rail to road transport. The exact number of facilities is searched until all demands (all nodes) are covered. To obtain the solution we use the already mentioned neighborhood search algorithm.

To avoid gradually adding more facilities and calculating the result of solution of p-median allocation problem for each variant (from one to the first optimal number of facilities), we can estimate the number of required facilities by curve of covering distance, which is also called p-median curve (Fig. 3). Estimation is confirmed, if the subsequent calculation accomplish to cover all demands of nodes.

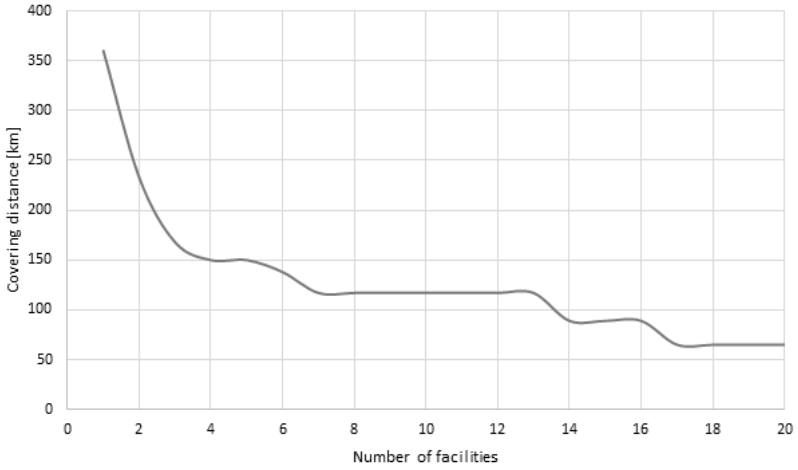

Fig. 3. Dependence between covering distance and number of allocated facilities

P-median curve descend until allocating seven facilities, then it changes only for certain number of facilities. Based on the curve we estimated the number of facilities for chosen covering distance. The estimation was confirmed by the application of the neighborhood search algorithm. We obtained the optimal number and location of facilities considering all chosen variants of covering distance. We also found the average and maximum distance from the facility to the nodes that this certain facility covers (Tab. 1).

Covering distance [km]	Number of facilities [P]	Facility location [Node number]	Average distance [km]	Maximum distance [km]
100	14	1, 9, 16, 21, 23, 29, 34, 44, 48, 52, 57, 65, 68, 70	21.6	89
150	4	7, 29, 44, 57	55.1	150
200	3	7, 36, 57	64.1	168

Tab. 1. Solution of p-median allocation problem on railway infrastructure (Authors).

Illustration (Fig. 4) shows the covering regions for the result of allocating three facilities. Numbers of served demands are almost equal for all regions. Most demands are served by facility located at node no. 7 (west region), since this region includes the capital city and three other large administration centers. It's up to 39.7 % of all demands (2 149 700 citizens).

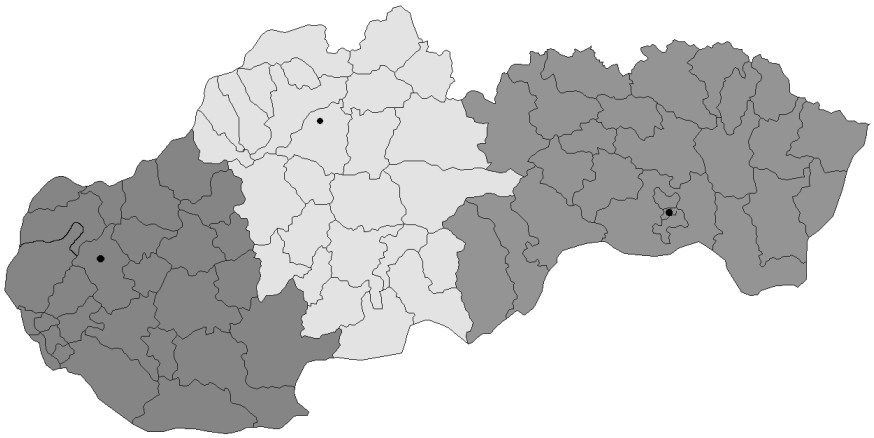

Fig. 4. Covering regions when allocating facilities for covering distance of 200 km (Authors).

Real situations demands to locate as little number of facilities as possible. The P-median allocation model can calculate the average and maximum distance from the facility to served nodes. The distance depends entirely on the number of allocated facilities. Since the available model and software requires to specify the value of covering distance, it is essential to use distance between the outermost nodes (605 km), ensuring that all demands are covered. The result are shown in below table (Tab. 2)

Number of facilities [P]	Facility location [Node number]	Average distance [km]	Maximum distance [km]
1	36	167.0	360
2	9, 68	108.4	233

Tab. 2. The obtained solution to the allocation problem with a minimal number of facilities

4. Conclusion

Using the P-median, we were able to allocate mail sorting centers on railway infrastructure while minimizing the average distance between the facilities and individual network nodes. The results can serve to understand the issue of interconnection between creating of postal network and the use of allocation theory for its optimization. The obtained solution is insufficient for the real system, due to the limited analysis of the underlying infrastructure. Further research will be

necessary to obtain detailed information so the designed network could simulate real conditions in more detail. It is essential to take into account not only the metric distance, but also other qualitative parameters, such as transportation time between nodes. Characteristic are also changes in the power supply traction of lines, which significantly affect the time and cost of transport. The ideal conditions are also suppressed by a complex system of organization of the transport on rail itself. However, the railway transport has a great potential and may be beneficial for the postal sector in the future. But there will be always need for synergy with road transport to ensure appropriate territorial serviceability.

Acknowledgement

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Comparison Amount of Fare-reduction in Suburban Bus Transport and Railway Transport

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Abstract. The paper deals with providing fare-reduction in public passenger transport – specifically suburban bus transport and railway transport, which are operated on the basis of public service contracts. First part provides overview about provided fare-reduction in suburban bus transport. Comparison amount of fare-reduction between suburban bus transport and railway transport is in next chapter. And also there is comparison among categories of passenger with free transport after 17.11.2015 in both of transport.
Keywords: suburban bus transport, railway transport, reduced fare.

1. Introduction

Suburban bus transport (SBT) and railway transport are operated on the basis of public service contracts. It means, that maximum price of fare isn't determined by transporter but it is determined by authority. Not only maximum price of fare but also amount of fare-reduction for individual categories of passenger are determined by authority. Authorities of suburban bus transport are self-government regions (Slovakia has eight self-government regions), in condition of Slovakia. Authority of railway transport (not only of regional but also of national railway transport) is Ministry of transport, construction and regional development of the Slovak republic. Such a high number of authorities of public services transport causes different price of fare but also different amount of fare-reduction for individual categories of passenger.

2. Providing reduced fare

Basic task of authority is ensuring of transport serviceability for reasonable fare, at whole territory of Slovakia. For this reason, authority determines not only maximum price of basic fare, which is "no reduced", but also amount of fare-reduction, which are designed for different categories of passenger, for example pupils up to 15 years, students up to 26 years, people over 70 years etc.

Amount of basic fare is determined on the basis of distance tariff, in suburban bus transport. Table 1 shows overview of amount of fare in €, for individual self-government regions. Amount of fare isn't the same for all self-government regions. Comparison of the shortest distance (up to 4km), difference between highest (0,70 € - BA) and lowest (0,50 € - PO, KE) fare is 40% (0,20€). Comparison of the longest distance (91-100km), the percentage different is lower in amount 11% and it is between highest (4,90€ - BB) and the lowest (4,40€ - NT) fare. However, in absolute term it is 0,40 € for one-way journey.

Tariff distance	BA	ZA	BB	TN	TT	NT	PO	KE
km	€	€	€	€	€	€	€	€
up to 4	**0,70**	0,65	0,60	0,60	0,55	0,55	**0,50**	**0,50**
5-7	0,80	0,75	0,70	0,70	0,60	0,60	0,60	0,60
8-10	0,90	0,80	0,75	0,80	0,75	0,70	0,75	0,75
11-13	1,10	1,00	0,95	0,90	0,90	0,85	0,90	0,90
14-17	1,15	1,10	1,05	1,05	1,05	1,00	1,10	1,10
18-20	1,25	1,20	1,20	1,15	1,15	1,10	1,30	1,30
21-25	1,50	1,50	1,50	1,35	1,35	1,30	1,50	1,50
26-30	1,80	1,80	1,85	1,65	1,70	1,55	1,70	1,70
31-35	2,00	2,00	2,10	1,90	1,95	1,80	1,90	1,90
36-40	2,05	2,15	2,30	2,00	2,10	1,95	2,10	2,10
41-45	2,20	2,30	2,40	2,30	2,25	2,05	2,35	2,35
46-50	2,45	2,60	2,75	2,55	2,50	2,35	2,60	2,60
51-55	2,70	2,80	3,00	2,80	2,75	2,60	2,85	2,85
56-60	2,85	2,90	3,10	3,00	2,95	2,75	3,10	3,10
61-70	3,20	3,30	3,45	3,40	3,30	3,10	3,40	3,40
71-80	3,60	3,70	3,90	3,90	3,70	3,45	3,80	3,80
81-90	4,10	4,20	4,45	4,30	4,30	4,05	4,30	4,30
91-100	4,50	4,60	**4,90**	4,75	4,70	**4,40**	4,85	4,85

Table 1, *Source: authors' processing on the base of dates from [2-10]*
Self-governing region: BA – Bratislava, ZA – Žilina, BB – Banská Bystrica, TN – Trenčín, NT – Nitra, PO – Prešov, KE - Košice

Also amount of fare is dependent on traveled distance, in railway transport. In comparison with suburban bus transport, tariff isn't divided into longer intervals (for example 18-20 km), but it is divided on intervals with value a kilometer. For this reason it isn't possible to make exact comparison of fare between suburban bus transport and railway transport.

Length of link, which is financially supported from public finance (it is part of public services contract), is maximum 100 km. On the other hand, links of railway transport are financially supported regardless this travel distance (100 km). It means, that student travels from Bratislava to Kosice (442 km) for reduced fare (with subsidy), by railway transport. Bus carrier hasn't subsidy, at this same transport of student.

Also amount of provided fare-reduction is dependent on the way of purchasing travel ticket. Next chapter deals with only one-way tickets, which is possible to purchase at driver (suburban bus transport), at sales points (railway transport - usually at the railway stations) or at guide (if sales points aren't at boarding places). Second option is purchasing tickets by contactless smart card. This option is only in suburban bus transport.

3. Payment by cash

This chapter deals with comparison of percentage amounts of fare-reduction for all passenger categories between suburban bus transport and railway transport. Payment for tickets is by cash. Comparison has been done for one-way tickets, which is possible to use only one time. The comparison is graphically shown in figure no. 1. Free public transport (fare-reduction 100%) is provided in suburban bus transport and railway transport for categories, which are shown in table 2. Change occurred 17.11.2014. Since this date, number of passenger categories with free transport extended to next categories – pupils, students and pensioner (people over 62 years).

Passenger category	Free transport	
	ZSSK	SBT
Pushchair of holder ŤZP a ŤZP-S	✓	✓
Wheelchair of holder ŤZP a ŤZP-S	✓	✓
Guide dog of holder ŤZP a ŤZP-S	✓	✓
[1] Baggage, which isn't oversize	✓	✓
Members of parliament (NR SR) and judges of constitutional court of SR	✓	only in region (BA, KE, NT, TT)
A pair of skis or snowboard	✓	only in region (BA, KE, TN)
Pushchair with child	✓	except region (PO, TT, NT)
2People over 70 years	✓	manipulation fee[2]
Pensioners (people over 62 years)	✓	X
Children up to 6 years	✓	X
Pupils up to 15 years	✓	X
Student up to 26 years	✓	X
Guide of the holder of ŤZP-S	✓	X

Table 2, *Source: authors' processing on the base of dates from [2-10]*
ZSSK – Železničná spoločnosť Slovensko, a. s. – railway transport (public service contract), NR SR – National council of the Slovak republic; ŤZP – severely disabled; ŤZP-S – severely disabled – guide.

This free transport is provided only in railway transport. This change doesn't apply to suburban bus transport. Railway transport in comparison with SAT provides free transport for guides of holders ŤZP-S (SAT → 40% reduction) and for children up to 6 years (guide of child → 0%). Suburban bus transport provides transport for children up to 6 years for manipulation fee, in regions BB (0,5€/25 km), TN (0,10€), and in ZA (0,5€/25km). Average amount of reduction is 43% in other regions. But SAT provides average reduction 43% for guide of child up to 6 years (railway transport → 0%). Except regions with manipulation fees, there is reduction 0%.

In case of one-way tickets in railway transport, the amount of fare-reduction is 60% for holders of ŤZP and ŤZP-S and amount of fare reduce is 50% for parents, which go to visit of disabled children, which are placed in health facilities. Pensioners up to 70 years haven't any fare-reduction in suburban bus transport. Pupils up to 15 years, students up to 26 years, holders of ŤZP and ŤZP-S, guide of holder ŤZP-S, parents, which visit disabled child in health facility, have average fare-reduction in value 40%

1 - Oversize baggage is bigger than 30x40x60 cm, cylinder shape over 150 cm long and average over 20cm, shaped plates over 5x90x100 cm

2 -

Region		BA	BB	KE	NT	PO	TN	TT	ZA
Fee	€/km	0,25/25	0,30/25	0,30/25	0,30/25	0,20/50	0,50 €	0,20/25	0,35/2
	€/1km	0,01	0,012	0,012	0,012	0,004	-	0,008	0,014

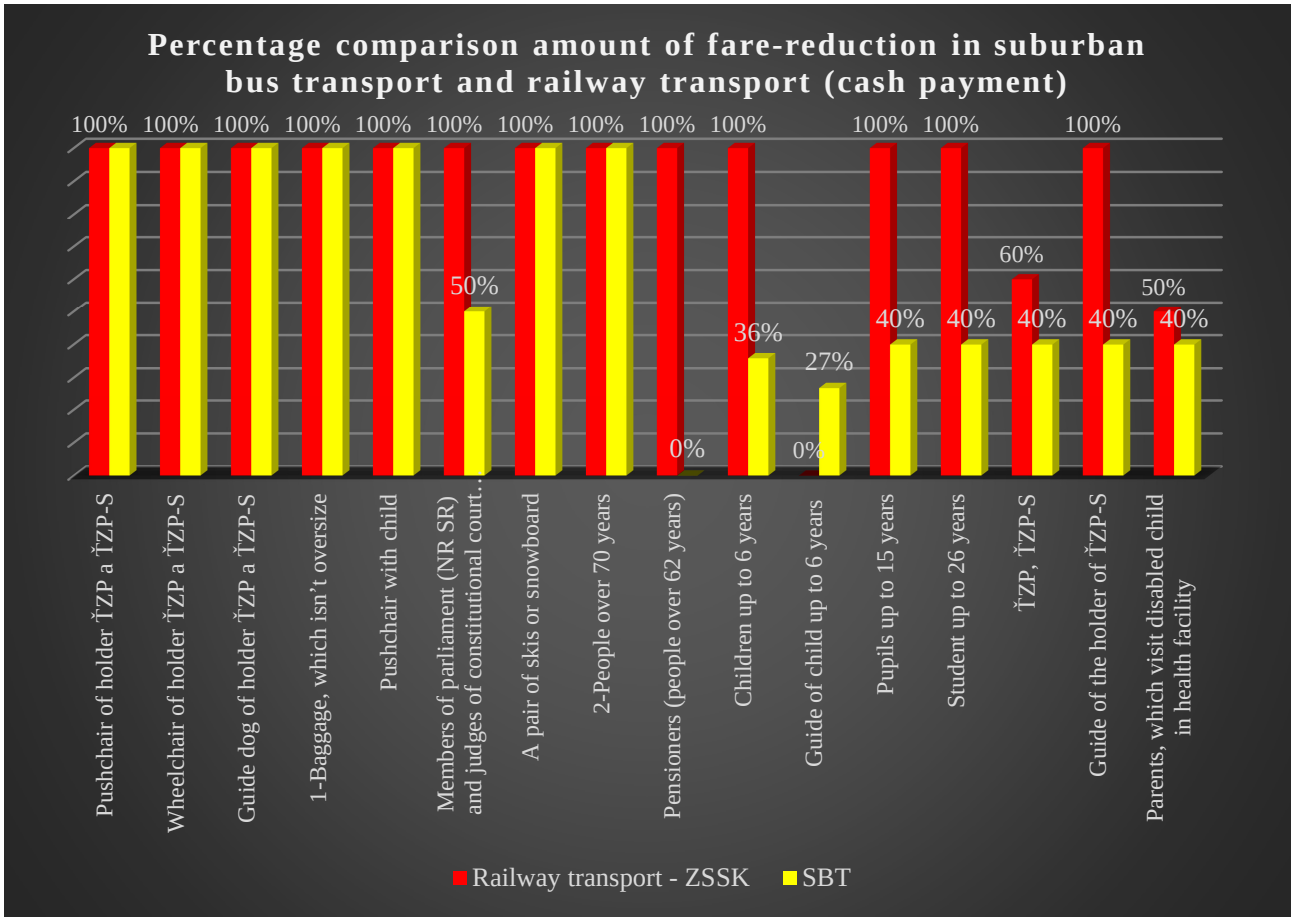

Fig. 1. Percentage comparison amount of fare-reduction in suburban bus transport and railway transport (cash payment), *Source: authors' processing on the base of dates from [2-10]*

4. Conclusion

Differences among amount of provided fare-reduction in public passenger transport – concretely in suburban bus transport and railway transport, have been found out by analysis. This difference has been found out not only between railway and suburban bus transport but also differences have been found out in SBT – among individual regions of SR.

Marked differences among fare-reduction in railway transport and SBT arose after 17.11.2014. Since this date, government of SR has set down free transport for students and pensioner only in railway transport (in spite of fact, that both of these transports are provided within public services contracts). Due to this fact, SBT isn't able to compete with railway transport. Also number of passenger in SBT has decreased, because passengers use to free transport in railway transport.

This fact discriminates citizens, which have claim to free transport but they haven't access to rail network. Within SR there are four district without rail network (Sobrance, Stropkov, Svidník a Námestovo) and three district without regular passenger transport (Krupina, Levoča and Veľký Krtíš) – there is rail network but passenger transport isn't operated. In this cases citizens have to use only suburban bus transport, which isn't free transport.

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[3] Tariff conditions of Self-government region of Banská Bystrica

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[10] Transport conditions of Železničná spoločnosť Slovensko, a. s. (General transport conditions)

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A Review of Selected Courier Companies Providing Services in Poland

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Abstract. This article describes the Polish Courier services market. Currently there are over 250 enterprises existing on the market, which offer express services. These companies are of both international and European range. They are competing with each other by shortening of delivery time, reducing the cost of delivery and introducing new services.

Keywords: TSL sector, KEP sector, courier company, courier broker.

1. Introduction

TSL (in polish: Transport- Forwarding- Logistic) is one of the fastest improving branches in Polish economy. It happens because of increase of electronic commerce (e-commerce). More and more people, in different age range, are persuaded to do online shopping. By Public Opinion Research Centre (PORC) in the middle of 2014 it was noted that 47% of Poles do shopping in the Internet. [1] Intensive growth of e-commerce causes that we can notice the increase in demand for courier services. Companies from CEP sector (Courier, Express Parcel), which is the part of TSL sector, outdo with each other by developing newer and newer, more convincing and innovated solutions, and in this way they apply for wider group of customers. Shortening of delivery time, reduction the cost of delivery and introduction of new services are the main activities in improving of quality. These processes could make company increasingly competitive on the market, where we can observe appearance of subsequent courier services companies. All of these actions give great benefits for clients, which have a wide range of offered services to choose.

For some time now there are also courier brokers existing on the Polish market. This entity mediate between the giants of CEP services and individual senders in the process of delivering. They don't possess own operational network, but usually use the networks of national courier companies and postal operators. Broker's role is to acquire customer, accept the order and hand on do CEP operator, and finally- to establish the payments. His offer allows to reduce the costs of delivering by 50% in relation to the amount of money, which must be paid in case of directly gaining the offers proposed by traditional delivering company. [2] However CEP operators don't waste on such solution, because of selling more services. Despite of necessity to limit the margin they still earn money, because the cost of individual customer handling decreases. Broker running a profitable business is able to ensure lower cost of services incurred by customers. Currently over 250 enterprises are offering the express services, companies are both of international and European range [2]. They are competing with each other not only on the national but also on the foreign markets. It is predicted that in the coming years still inexhaustible potential of courier services branch will achieve turnover similar to turnover observed in western European companies. This article is presenting the analysis of actual polish courier services market.

2. Polish courier services market

Among the companies providing their activity in the whole world, and the same time the most significant companies on the polish market, we can distinguish UPS (United Parcel Services). In Poland it started activity on 29th of April in 2005 by transaction of purchase the Messenger Service Stolica S.A. Currently Messenger Service Stolica S.A., as corporation dependent of UPS, has one of the largest line-haul system, which allows to carry more than 50 000 parcels to their 42 branches in the whole country. Company employs more than 2700 people including 1500 couriers [3].

The next company providing services in Poland is DHL, which is the part of the leading corporation in the field of postal items and logistics- Deutche Post DHL Group. The company exists in Poland since 1991 under the name DHL Express. It employs above 5000 workers, comprises 4 sorting plants, 6 flights sorting plants, fleet of 3 aircrafts and 2300 courier routes. In case of international deliveries, subject to customs clearance, DHL guarantees full service in this range too. The ability to confer various parcels (if it comes to weight of parcels, dimensions, shapes) causes that DHL is one of the most flexible couriers on the polish market [4].

The next company is TNT, which exists on the Polish market for more than 20 years. It specializes in express reception and distribution of documents, parcels and freights. In Europe TNT has integrated network of connections among 44 countries. This company can be proud of having the largest infrastructure when talking about delivering by air and road transport in system “from door to door”. TNT Express belongs to leaders when it comes to courier services market for institutional clients [5].

Company FedEx (Federal Express) is the next foreign company, which works on the Polish territory. That’s an American company involved in the transport of consignments and in logistics, mainly by planes. FedEx as the first company started transportation of air express consignments to Russia and other former socialist countries in East Europe. In Poland it launched on 14th of June 2012 by purchasing another, famous courier company- OPEK, which existed on the Polish market since 1994 [6].

Company owned by one of the leading courier carriers serving the entire Europe is DPD (Dynamic Parcel Distribution), forwarding company based in Germany. DPD Poland (formerly Masterlink Express) was established in 1991 as a company, which was founded in one hundred percent of Polish capital. Currently, the main shareholder of DPD Poland is the Swedish Post, the company specializes in delivering of items with different range- not only in Poland but also abroad. In addition it offers logistics, freight forwarding and customs services. In Poland, there are more than 50 regional branches in which DPD Poland employs approximately 5500 employees and associates, and has a fleet of almost 3,000 vehicles [7].

Another leading pan-European company operating in Poland is the GLS (General Logistics System). It runs on courier freight market since 1999 as part of the Royal Mail (UK company registered mail). In Poland, it provides services through GLS Poland sp. z.o.o., whose headquarters are in Głuchow. The company has 30 subsidiaries throughout the country. Central sorting plant is located in Strykow and is used as an international loading point. GLS Poland has 1,000 points of GLS Parcel Shop, which represent an alternative delivery addresses enabling the recipient to receive the package in a situation when he or she is not present in the house during the first attempt of delivery. Further the sender can also take an advantage of shipping options through ParcelVan, by contacting the GLS Poland and asking to arrange receipt of the package by courier within the service ParcelVan [8].

Among the foreign companies that operate on the Polish CEP market is also K-EX. It provides services in transport and general cargo express carriers with delivering to the next working day after posting. In Poland there are 28 regional offices, which are systematically developed. Shipments ordering system is one of the simplest and most effective on the market. K-EX supports currently 7 270 companies and institutions [9].

Speaking about the courier consignments it should also be mentioned about another European company providing services in Poland. It is founded in the Netherlands, Raben Group, which specializes primarily in shipments of heavy and large size consignments.

It is one of the most important players on the Polish forwarding market due to a large fleet of its own, a good knowledge of the industry and proven facilities in the form of the contract fleet, which is managed, but not administered by the shipper. It is extremely convenient for broadcasters of transport services because Raben has extensive experience and is flexible in negotiating transport contracts. Moreover, it provides subcontractors with the service of used fleet and purchase of the fuel, which reduces the cost of activities and raises the efficiency of its operations [10].

However, the beginnings of a courier services in Poland are attributed to the postal operator- the Polish Post Office. It works in the industry since 1995 offering both support for domestic (Pocztex) and foreign (EMS) shipments [11]. The company is characterized by high dynamics of growth of courier services. According to data from Polish Post Office in the first 9 months of 2014 there was 40% more postal courier compared to the same period last year [12]. The following graphs show results of studies on the number of postal items registered in Poland in the period from 2004 to 2013 [13], detailing the types of consignments (express, ordinary and insured items). Each one of those analysis includes both of domestic and international items divided into dispatches and receipts. Not all data are available to the public- on the graphs it is "0".

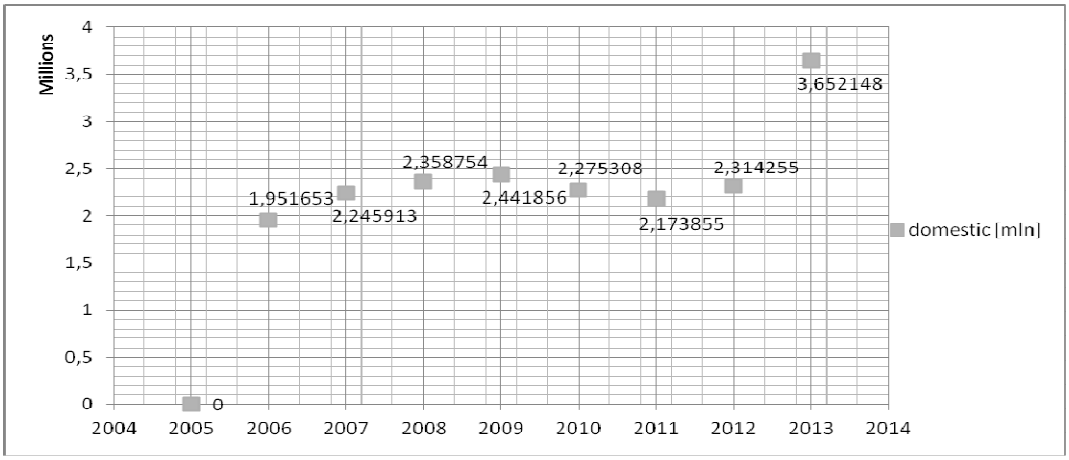

Fig.1. Graph I- the number of domestic express consignments in the period 2005-2013 [13]

The first graph show the number of express consignments carried out in Poland. From 2005 to 2012 it oscillated around 2 millions of items. There was observed a sharp increase in 2013 (in comparison with the 2005- almost a twofold increase). It happens because of tremendous development of e-commerce sector and hence the growth in demand for courier services.

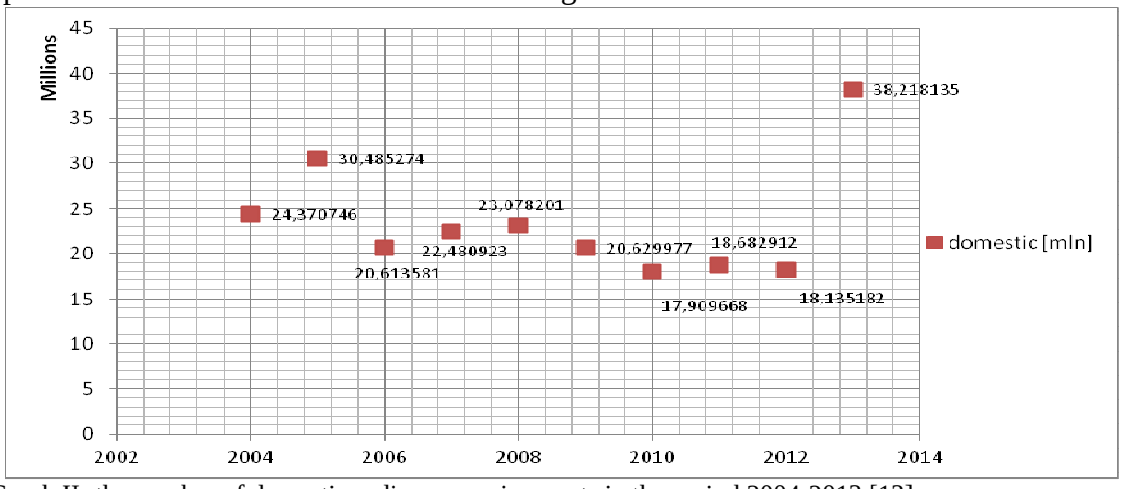

Fig.2. Graph II- the number of domestic ordinary consignments in the period 2004-2013 [13]

The similar situation is when it comes to the domestic ordinary items (showing on the second graph). From 2004 to 2012 the number of consignments remained at a level of approx. 20 millions, while in 2013 there was observed more than a twofold increase in comparison with the previous year.

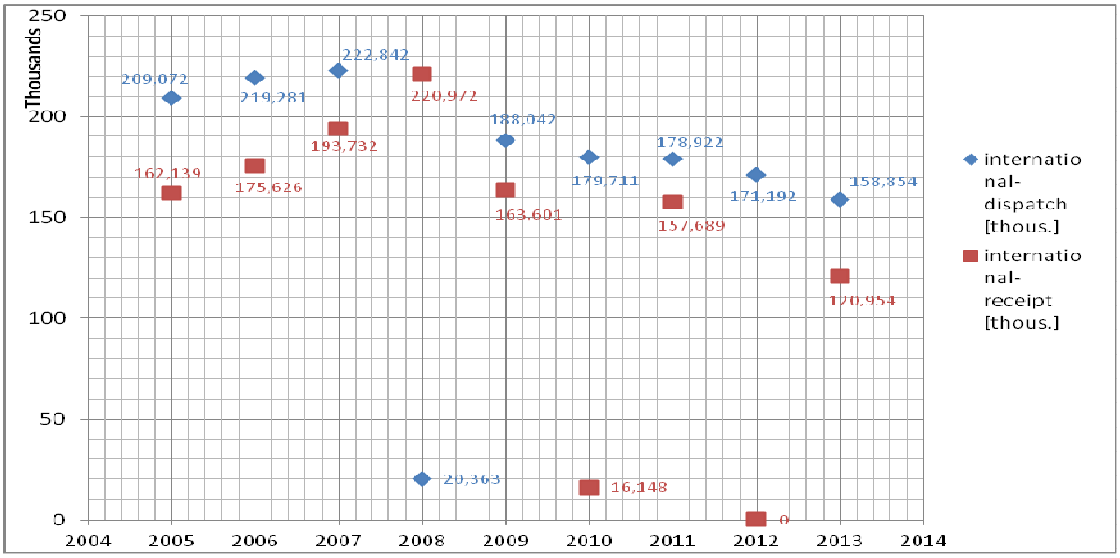

Fig.3. Graph III- the number of international express consignments in the period 2005-2013 (The data about number of items registered in the period 2005-2010 applies only to EMS items) [13]

The third graph illustrates the number of the international express consignments. From 2007 it began to decrease gradually. This happened due to entering the Polish market and intensive development of courier companies offering international services. Growing number of these companies and their competitive offers contributed to a decline in the number of foreign shipments supported by the Polish Post.

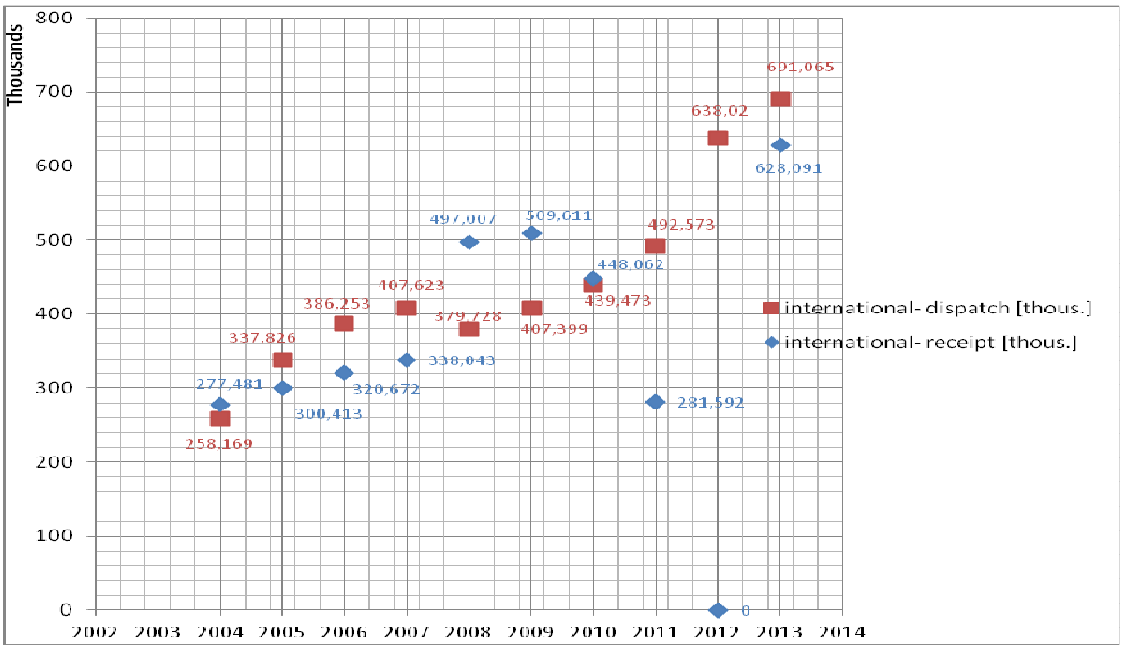

Fig.4. Graph IV- the number of international ordinary consignments in the period 2004-2013 [13]

The fourth graph shows the opposite trend for ordinary international shipments when the time of delivery is not as important as for customers using express services, but the most important is the low cost of delivery.

Another independent postal operator operating in Poland since 2006 is InPost. It offers both traditional and non-standard postal services to individual clients, businesses and public sector institutions. Since the liberalization of the postal market (ie. From 01.01.2013r) InPost steadily increases its market share at the expense of the Polish Post. The most famous InPost service are Packstations that allow transmission and reception of shipments 7 days a week, 24 hours a day, no queues, and in convenient location. Packstations of InPost are already present in 20 international markets, including Great Britain, Italy, Saudi Arabia, Australia, Slovakia, and Ukraine. Currently, the company has offices in 18 Polish cities through a network of 800 points of customer service. In 2013, the company delivered 240 million packages [14].

Table 1 shows the number of establishments of selected CEP industry operators in Poland based on own analysis. By analyzing the data in Table 1 it is clear that the number of branches of the Polish Post exceeds the total number of other operators. This is because of its more than 455-year tradition.

Name of company	Number of establishments (in Poland) [-]
UPS	**46**
DHL	**61**
TNT	**23**
FedEx	**4**
DPD	**49**
GLS	**26**
K-EX	**No data**
Raben Group	**No data**
Polish Post	**8075**
InPost	**618**
OPEK	**40**
Siódemka	**33**

Tab.1. Number of outlets and the number of items delivered by selected courier companies [15].

Analysing the opinions of 454 673 customers and users opineo.pl (representing Poland's largest platform collecting opinions on goods and services), website kurierem.pl prepared the ranking of companies from CEP branch which is presented in Table 2. Analysing the data in Table 2 should be noted that differences in interpretation between the first and eighth place are 1.3 points, reflecting the large courier companies care about the quality of their services.

The place in ranking	Name of company	Number of opinions	Overall rating (on a scale 1-10; 1-lowest rating, 10-highest rating)
1	**UPS**	**55826**	**9,1**
2	**DHL**	**55528**	**8,9**
3	**DPD**	**68100**	**8,8**
4	**GLS**	**25327**	**8,8**
5	**FedEx**	**2134**	**8,4**
6	**Opek (belonging to FedEx)**	**5005**	**8,2**
7	**TNT**	**306**	**8,2**
8	**Pocztex**	**3800**	**7,8**

Tab.2. Ranking of couriers (2015) [16].

According to the statistics of the Polish Post the most important factors influencing the choice of supplier of shipments are: timely delivery (41%), favourable prices of services (34%) and lack of damage (22%). In addition to these three factors, customers appreciate the lack of disappearances of the consignments (20%), In addition to these three factors, customers appreciate the lack of disappearances of mail (20%), high efficiency service to individuals (18%), the ability to track shipments (16%), short waiting time to receive the consignment (15%), or a flexible offer tailored to individual needs (12%) [12]. As you can see, customers require courier companies to meet a variety of factors, forcing their development, and thus increase the quality of services offered.

3. Conclusion

CEP industry in Poland is growing rapidly for many years. Continuous development of logistics and transportation technology offers great leeway courier service providers in introducing new services, thereby adapting to the constantly increasing demands of customers. Courier companies systematically enrich the scope of its services in order to gain more and more customers. To meet the expectations of the courier services customers when it comes to quality and lowering their cost, a new entity developed in the CEP industry, which is a courier broker. But the most important factor increasing the dynamics of Polish CEP industry development is the development of electronic commerce.

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Organization of Post Transportation on the Territory of Ukraine

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Abstract. The paper presents the basic rules of postal operators functioning on the territory of Ukraine. It also gives a brief description of organization of national postal operator "Ukrposhta". The basic rules of post transportation by road, air and rail are considered there.

Keywords: Post service, post transportation.

1. Introduction

Post service is an integral part of the development and functioning of the state. Its organization and operation has its own characteristics in each country. Ukrainian state enterprise of postal communication "Ukrposhta" is a state postal operator of Ukraine and is governed by the Ministry of Infrastructure of Ukraine. It is the national postal operator in Ukraine according to the Decree of the Cabinet of Ministers of Ukraine dated January 10, 2002, being a member of the Universal Postal Union since 1947 [1].

2. The some information about Ukraine postal operator

2.1 Basic indicators of enterprise work

"Ukrposhta" has about 11,800 post offices throughout the country. The company employs 85,500 workers, who process and deliver more than 240 million consumers post annually, 16 million parcels and sendings with agreed value, 15 million transfers, deliver more than 83 million pensions. Direct post delivery is carried out up to 15 million mailboxes. It delivers 10 thousand of periodical titles, or more than 700 million copies a year to subscribed customers and in retail. It transports about 30 thousand tons of subscriptions per year with the total mileage of vehicles more than 86 million kilometers. Law of Ukraine "On PostalService" regulates the activity of postal operators, including issues relating post transportation, as well as vehicles that perform them.

The main indicator of the postal operator efficiency is the amount of postal dispatches. Tab. 2.1 presents the numerical values of dispatches from 2009 to 2012 [2].

Type of dispatch	2009	2010	2011	2012
Dispatch of newspapers and magazines	1204000000	1089000000	1006000000	1019000000
Dispatch of letters	301000000	311000000	320000000	387000000
Dispatch of telegrams	1970000	1634000	1358000	1130000
Dispatch of parcels	15356000	17546000	18481000	45267000

Tab.2.1. The amount of postal dispatches

Analyzing the data, we can conclude that the number of dispatches of newspapers and magazines during the last 4 years decreased by 15.4% as well as the number of dispatches of telegrams - by 42.6%. The number of dispatches of letters increased by 28.6% and parcels almost twice (Fig. 2.1).

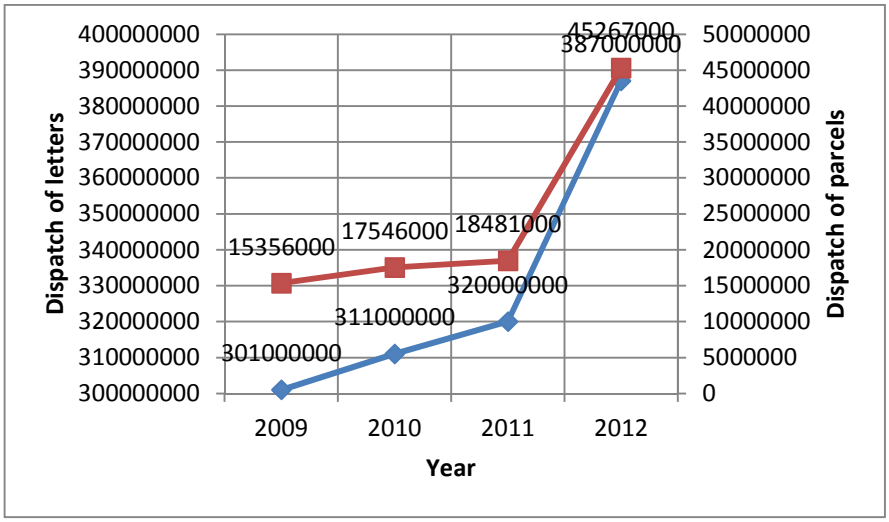

Fig. 2.1. The amount of letter and parcel dispatches

Operators for the transportation of post use their own vehicles, as well as transport of physical and corporate bodies on contract basis [3]. Transportation of post by road, water, rail and air transport is carried out on a contract basis in accordance with the laws of Ukraine.

Delivery of post using public transport, as well as post overload is done on a priority basis. Trains admission, part of which the special equipped wagons for transportation of post are, must be carried out on the platforms and railways where the necessary conditions for the exchange of post are provided. Post transportation is realized with road transport on line haul, intraregional, inter-district, intra-district, urban and access postal routes [4].

According regulations postal transportation is performed:

- on the line haul routes - daily, at least once per day;
- on the intraregional routes - at least six days a week and once per day;
- on the intra-district routes - at least five days a week and once per day;
- on the urban routes –not less than six days a week and twice per day.

2.2 Transportation of post by road

On postal routes post is transported by specially equipped vehicles with locked car bodies, which are outfitted with value boxes, that have locks as well. The car body must have internal lighting and signaling, which is regulated from the driver's cab. If the post is transported in a vehicle with an open car body, it should be packed tightly, covered with a tarpaulin, and tied up in such a way in order to guaranty the safety throughout the rout and to prevent ingress of dust or moisture.

According to construction form postal routes are divided into radial, circular and combined. Postal route is organized taking into account features of passageways, achievement of fast movement of post and the most effective usage of transport and material resources. Urban postal routes are organized taking into account current conditions of processing and delivery of various types of post.

Ukrainian postal network has multilevel hierarchical structure that, in general, follows the structure of the administrative-territorial system of Ukraine. Fig. 2.2 shows a scheme of magisterial transit post provider which is done by the national post operator "Ukrposhta".

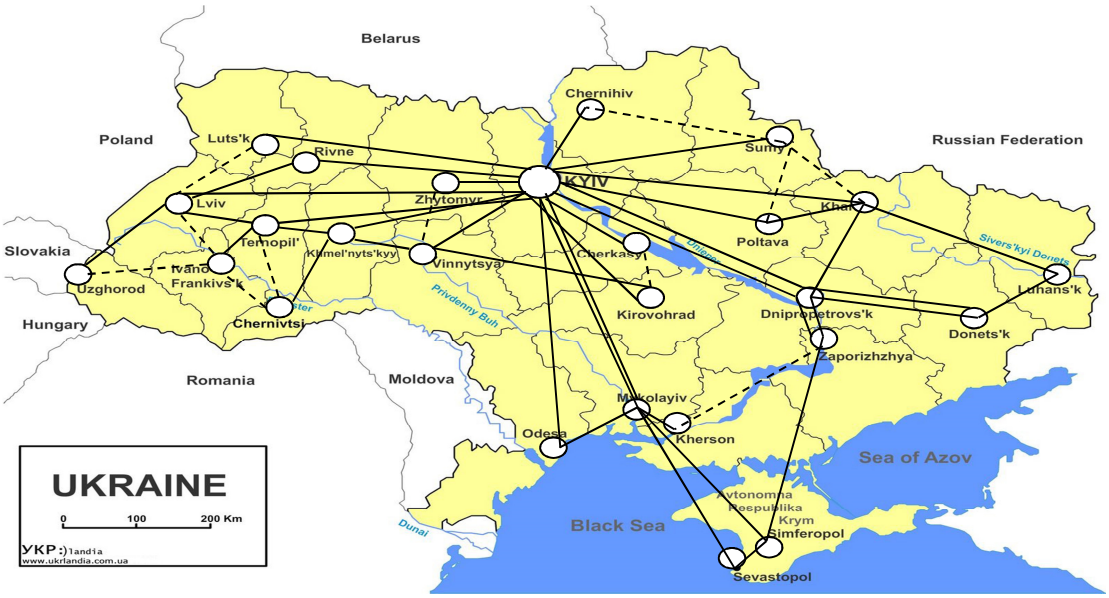

Fig. 2.2. The scheme of magisterial post transportation done by the national Ukrainian operator "Ukrposhta";
◯ the main post centers, —— basic automobile routes, ---- automobile routes in emergency cases

Tab. 2.2 presents characteristics of existing postal magisterial routes of post transportation.

№	Route	Length, km
	Main automobile routes	
1	Kyiv-Chernihiv-Kyiv	370
2	Kyiv-Sumy-Kyiv	841
3	Kyiv-Kharkiv-Lugansk-Kharkiv-Kyiv	1791
4	Kyiv-Kharkiv-Poltava-Dnipropetrovsk-Kyiv	1281
5	Dnipropetrovsk-Kyiv-Kharkiv-Poltava-Kyiv	1311
6	Kyiv-Dnipropetrovsk-Donetsk-Dnipropetrovsk-Kyiv	1517
7	Kyiv-Dnipropetrovsk-Zaporizhia-Dnipropetrovsk-Kyiv	1234
8	Kyiv-Cherkasy-Kyiv	492
9	Kyiv-Kirovohrad, Kyiv	709
10	Mykolaiv-Kyiv-Simferopol-Mykolaiv-Kyiv	1721
11	Kyiv-Mykolaiv-Kherson-Mykolaiv-Kyiv	1187
12	Kyiv-Odesa-Kyiv	1011
13	Kyiv-Vinnytsia-Kyiv	559
14	Kyiv-Zhytomyr-Kyiv	278
15	Kyiv-Khmelnitsky-Chernivtsi-Khmelnytsky-Kyiv	1149
16	Kyiv-Ternopil-Ivano-Frankivsk-Ternopil-Kyiv	1283
17	Kyiv-Lviv-Uzhgorod-Lviv-Kyiv	1649
18	Rivne-Kyiv-Lviv-Rivne-Kyiv	1135
19	Kyiv-Rivne-Lutsk-Rivne-Kyiv	875
	Regional automobile routes	
20	Dnipropetrovsk-Donetsk-Luhansk-Donetsk-Dnipropetrovsk	888
21	Dnipropetrovsk-Zaporizhzhya-Simferopol-Zaporizhzhya-Dnipropetrovsk	1004
22	Dnipropetrovsk-Mykolaiv-Odesa-Mykolaiv-Dnipropetrovsk	958
23	Dnipropetrovsk-Kirovohrad-Vinnytsya-Kirovohrad-Dnipropetrovsk	1200
24	Sevastopol-Simferopol-Sevastopol	200
25	Sevastopol-Mykolaiv-Sevastopol	885
26	Lviv-Ternopil-Khmelnytskyi-Vinnytsya-Khmelnytskyi-Ternopil-Lviv	788
In total		26316

Tab. 2.2. The list and basic parameters of postal routes scheme

Acceleration of postal sending's movement and rational usage of vehicles is possible at the expense of post traffic combination with appropriate routes. The choice of the traffic combination options of the post depends on the following basic conditions: 1) the start and end time of road transport passages for the post exchange with post offices or post exchange stations, which depends on working schedule of post enterprises, as well as on newspapers publishing or their arrival with other means of transport; 2) the start and end time of road transport passages for taking out of correspondence from mailboxes, which is determined by taking into account the guarantee of timely processing and sending of outgoing correspondence, as well as the delivery of local correspondence in compliance with current deadlines. Intra-district rout transportation is organized in such a way so that the periodicals and correspondence could arrive to the last post office on time, and outgoing correspondence from post office could arrive to the communication site on the day of its taking out from mailboxes or registration in post offices.

During the traffic organization the post offices together with the motor transport enterprises inspect road conditions, measurement of distances and time expenditure of transport on postal routes. Acts of distance measurements and time expenditures of transport movement are used while creating the schedule of post transport on postal routes, its passports, as well as for monitoring the usage of the rolling stock on the line during the processing of waybills. While creating the schedule for post transport one should take into account the following aspects:

1) time when the main mode of transport (rail, air, road) passes the post exchange points;
2) guidelines of exchange frequency and post transportation;
3) established speed of vehicles movement;
4) flows of postal sending's, which exist on particular routes.

Vehicle speed during post transportation is determined in the accordance with the condition of the road surface on the route, the technical capabilities of the vehicle, the permitted speed limit.

2.3 Transportation of post by air

Transportation of post by aircraft within Ukraine and on international flights is realized in accordance with the plans of the direction of airmail due to aircraft schedule. While creating the plans of the direction of airmail direct flights between departure and destination points are chosen. In case there is no direct flight, the route is created to minimize the number of transit overloads. Meanwhile the transit airports are selected as they provide minimum time of post overload. Transit dispatches are sent with outgoing dispatches in the timeframes established by the schedule of aircraft movement. Post offices are required to submit, and the airlines - accept post for carriage within the timeframes specified in the contract. Post offices are required to provide the airlines with post sending's for delivery by aircraft within Ukraine, packed in accordance with postal regulations; for international flights - packed in accordance with the requirements of the acts of the Universal Postal Union.

2.3 Transportation of post by rail

Post is transported by railway in the mail cars of post office as well as in mail cars of Ukrzaliznytsia included to all kinds of trains. Post transportation can be realized on the specially adapted passenger seats, luggage vans or platforms of carriages at the expense of post offices. The mail cars can be included to the train formation by railways on the basis of the train list suitable for post transportation, which is made by post office before annual changes or corrections of train schedule. The list includes the number of trains, in which run mail cars, their location in the train, the frequency of running, as well as the number of trains in which post is transported in the luggage van or individual passenger compartment

Railroads are required to provide facilities for processing and storage of post, railways and dead-end sidings for stops of mail cars, platforms, tunnels, lifts, etc.

Over the next five years, "Ukrposhta" plans to significantly accelerate the delivery of letters and parcels, as well as to implement specialized online services. Also up-to-date automated sorting centers will be created and the standard speed of letters delivery will be increased from 5 to 3 days, for parcels- from 7 to 3 days, for newspapers -from 2 days to 1 day, centralized integrated informational system ERP will be implemented; on-line services will be developed and informational support of the operations will be supplied. The amount of mobile post offices for remote and under populated districts will be increased. The company plans also maintain and renovate all post offices, including rural and update the vehicle fleet [5].

3. Conclusion

The postal communication "Ukrposhta" is a state postal operator of Ukraine. Law of Ukraine "On PostalService" regulates the activity of postal operators, including issues relating post transportation, as well as vehicles that perform them. In the future "Ukrposhta" plans to significantly accelerate the delivery of letters and parcels, as well as to implement specialized online services.

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Evaluation of Wagon Impact Tests by Various Measuring Equipment and Influence of Impacts on Cargo Stability

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Abstract: This article deals with impact tests of wagons, evaluation of impacts from various measuring equipment and influence of impacts on cargo motion in the wagons when various manners of cargo securing were used. The accelerations generated during impacts were observed also by monitoring units designed for monitoring of transport and by recordings from cameras GoPro Hero. Instead of observing the influence of impacts on the cargo loaded in impacting wagons, there was also observed the function of the monitoring units in closed building with not very good GSM signal.

Keywords: impact tests, wagon, acceleration, lashings

1. Introduction and description of measuring equipment

This article deals with impact tests of wagons, evaluation of impacts from various measuring equipment and influence of impacts on cargo motion in the wagons with various manners of cargo securing. For these purposes there was done 10 impact tests, for which the following wagons were used:

Wagon type	Loading length (m)	Lenght including buffers (m)	Wagon weight (kg)	Cargo weight (kg)	Total weight (kg)	Floor	Buffers
Impacted wagon							
Eas	12,8	14,04	22 500	52 000	74 500		cat. A
Impacting wagons							
Res	18,5	19,9	24 100	31 740	55 840	wooden	cat. A
Rils	18,53	19,9	24 000	44 284	68 284	wooden	cat. A

Tab. 1 Description of wagons used for the impact tests

For acceleration measuring there was used following equipment:

- equipment Saver 9X of University of Žilina in Žilina, placed in the middle of the impacting wagon;
- equipment MoniLog EnDal Curve of ČD Cargo, placed in the middle of the impacting wagon;
- monitoring units A1 and A2 equipped by tri-axial accelerometers, fixed on the wagon by magnetic plates, both placed one close to another on the side of impact of impacting wagon in the same height as buffers. These units can be used for monitoring of transport (including intermodal transport) and can automatically detect the accident situations;
- monitoring units X1 and X2 equipped by tri-axial accelerometers, fixed on the wagons by magnets. Unit X1 was placed on the impacted wagon and X2 on the impacting wagon on the

side of impact. These units are other type of monitoring units used for monitoring of transport (including intermodal transport) and also can automatically detect the accident situations

- 6-axis MotionTracking device (in the table as MT6) equipped by tri-axial accelerometer and tri-axial gyroscope, for purposes of these tests was the accelerometer set to range +/- 8g;
- 2 cameras GoPro HD Hero 3. Recording from them were processed by the Tracker software and then there was calculated acceleration in longitudinal axis x.

All the wagons were during the impact tests loaded by coils of wire weighting about 2 000 kg/coil. 10 impact tests were done in three series with different wagons and cargo loading:

- in the first series there was used the wagon Res as an impacting wagon, there were done 2 impact tests in front direction (down stated as Res F01 and Res F02) and one test in reverse direction (Res R03);
- in the second series there was used the wagon Res again, but the way of cargo securing was different. There were done 2 impact tests in front direction (down stated as Res F04 and Res F05) and one test in reverse direction (Res R06);
- in the third series there was used the wagon Rils as the impacting wagon, there were done 2 impact tests in front direction (Rils F07 and Rils F08) and 2 in reverse direction (Rils R09 and Rils R10), because of the low speed before shock in the test Rils R09.

The tests were done in the closed hall where the temperature was from 5 to 7 °C.

2. Impact tests and their influence on loaded cargo

The maximum recorded accelerations in longitudinal axis x by particular equipment (instead of GoPro cameras from which there are stated the average accelerations in the impact time of 0,06 to 0,125 s) are stated in the table 2. Particular series of impact tests are highlighted by different colours.

Impact test	Speed before impact (km/h)	in the place of impact				in the middle of the impacting wagon			
		A1	A2	X1	X2	MT6	Saver 9X	EnDal Curve	GoPro Hero 3
Res F01	5,76	1,56	1,68	1,01	1,34	1,48	2,24 to -2,01	N/A	1,57
Res F02	8,67	2,12	2,04	1,54	1,76	2,48	N/A	N/A	1,69
Res R03	8,89	2,06	2,08	1,21	1,31	1,41	3,30 to -2,08	1,82	1,92
Res F04	6,67	1,60	1,48	1,17	1,18	2,44	2,14 to -1,12	N/A	1,42
Res F05	11,08	0,20[3]	0,20[3]	1,40	1,23	2,06	N/A	N/A	1,84
Res R06	10,14	2,32	2,00	1,39	1,78	2,02	N/A	2,32	3,13/2,18[1]
Rils F07	6,99	1,44	1,56	1,11	1,09	1,60	0,82 to -0,71	N/A	1,37
Rils F08	8	1,72	1,88	1,45	0,57	1,16	2,01 to -4,33	N/A	1,61
Rils R09	5,33	1,16	1,08	N/A	0,93	0,95	0,81 to -0,72	N/A	1,67/0,81[2]
Rils R10	10,14	2,16	2,20	1,25	1,22	1,39	1,01 to -0,83	N/A	2,99

Tab. 2 Accelerations in axis x recorded in particular impact tests. All the values of accelerations are stated in

[1] higher value has been found out in the time of 0,075 s, the lower one in the time of 0,125 s. Impacted wagon moved after the impact

[2] higher value has been found out in the time of 0,075 s, it is also possible to evaluate the decelleration as 0,81 g in the time of 0,2 s

[3] in these cases the monitoring units evaluated other shock instead the shock during the impact. This shock actuated mainly in vertical (z) axis and occured immediately before the impact, when the impacting wagon passed through obstacle on the track

In the first series of impact tests the Res wagon with 16 coils was used as an impacting wagon. 15 coils was loaded on the floor, one coil was placed in the upper layer in the saddle between 8th and 9th coil from the front. There was a space of 60 cm between these coils. The coil in the upper layer was fixed with each of them by polyester lashing strap with the lashing capacity 3 000 daN (pic. 1 in the left). In the transverse direction was not used any blocking of cargo, only the friction between coils and wagon floor.

After the first impact (Res F01) the coil in upper layer skipped up and all the coils moved frontwards (closer to impacted wagon). Space under the coils in upper layer was shortened from 60 cm to only 5 cm and in the rear part of wagon the space of 40 cm was created. After the second impact the same situation was repeated and the coils in the front part of wagon pushed more one onto another while the space in the rear part of wagon was lenghtened to 50 cm. The third impact was done in reverse direction. The coil in upper layer skipped up again and all the coils moved frontwards (in direction to impacted wagon). There was created the space of 40 cm between the last coil in the rear and the wagon rear sidewall. The space under the coil in upper layer lenghtened from 5 to 15 cm. This manner of cargo securing can not be considered as satisfying because of cargo movement after all the shock, when in the rear part of wagon the coils can move not only in longitudinal direction but there is also a risk of their movement in transversal direction. The coil in upper layer does not fulfil crowding-out effect.

The second series of impact tests was done with the same wagon and cargo loading distribution, but the way of securing of upper coil was different. The upper coil was secured by loop lashing by two straps to the lashing points of wagon. After the first impact (F04) the cargo did not move. After the second impact there was generated a free space of 5 cm in the rear part of wagon and the space under the upper coil shortened by the same length. Speed before impact was in this case higher than there is recommended by UIC requirements for the impact tests. In the reverse impact R06 was the shock generated in the side with space and whole cargo moved frontwards to the place where had been this space. The space of the same length was created in the rear part of wagon. According to the most of equipment which was used the biggest acceleration in longitudinal axis x was generated in this reverse impact (see table 2).

Fig. 1 Securing of the coil in upper layer in the first series of impact tests (in the left) and in the second series of impact tests (in the right)

In the third series of impact tests the wagon Rils was used. The wagon was loaded by 22 coils, 15 of which on the floor and 7 in the upper layer. The coils 1 to 3 and 5 to 7 were fixed always by loop lashing with two lashing straps to lashing points of wagon (see fig. 2 and fig. 3), only the middle-placed coil no. 4 was lashed by lashing straps only with the neighbouring coils placed on the floor and there was a space with length of 60 cm under it. Neighbouring coils were separated by 5 mm thick cartons. The cargo was blocked against the transversal movement by wooden profiles. After the first impact (F07) the coils in upper layer skipped up but any movement of cargo was not

detected. The forces in lashings in the front part of impacting wagon increased, but lashing in the rear part of the wagon became looser. After the second impact (F08) the 5 cm long space was generated in the rear part of the wagon. This spaced was generated because the coils pushed on into another and the space under the coil no. 4 was not shortened. Speed of impacting wagon before the third impact in reverse direction (R09) was very low, so the reverse impact test was repeated. In the repeated reverse impact test R10 the cargo moved frontwards and 5 cm long space was generated in the rear part of the wagon. Loose lashing straps in the front part of wagon (which had been its rear part in F07 and F08) became tightened and in opposite, the straps in the rear part of the wagon became looser.

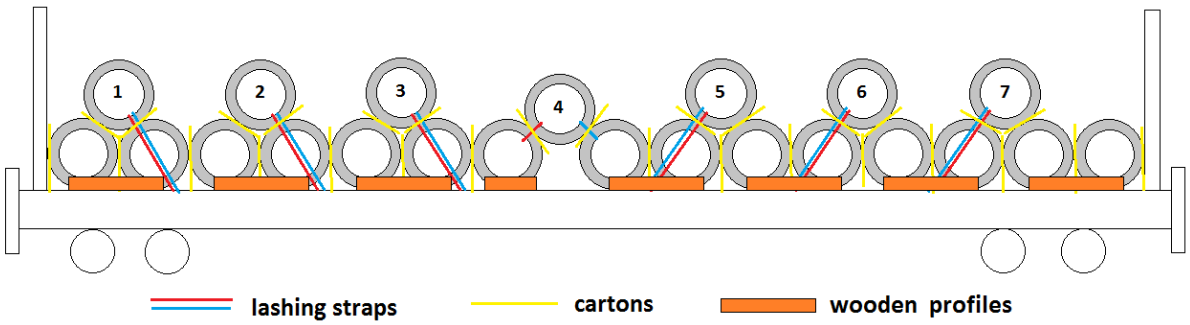

Fig. 2 Cargo loading on the wagon Rils in the third series of impact tests

Fig. 3 Lashing on the wagon Rils in the third series of impact tests

The acceleration in the place of impact were measured by four monitoring units which are used for monitoring of road, rail or intermodal transport and are also equipped by accelerometers with a function of accident situations detection. Units marked as A1 and A2 were placed in the same height as wagon buffers and in general these units recorded higher values of acceleration than units called X1 and X2 placed about 75 cm higher. In the table 3 there are stated the average values of accelerations in axes x, y and z from all the measuring equipment excepting GoPro Hero 3 cameras and equipment Saver 9X, data from which was not included because of unsuitable structure of data. Incorrect data from two monitoring units in impact test Res F05 are also not included to the average.

Impact test	Average accelerations		
	longitudinal (x)	transversal (y)	vertical (z)
Res F01	1,44	0,59	0,47
Res F02	2,17	0,53	0,45
Res R03	1,64	0,26	0,46
Res F04	1,90	0,48	0,36
Res F05	1,69	0,49	0,64
Res R06	2,02	0,44	0,66
Rils F07	1,45	0,45	0,67
Rils F08	1,28	0,51	0,85
Rils R09	1,01	0,07	0,27
Rils R10	1,55	0,19	0,34
Average	1,61	0,40	0,52

Tab. 3 Accelerations in three axes in particular impact tests as average from various measuring equipment

The highest accelerations were reached in the longitudinal axis x. In several cases the impacted wagon moved after the impact, mostly in the tests Res F01, Res F02, Res F05, Res F06 and Rils F08. Accelerations in axis y were recorded as about 25 % of that in axis x, and average value of accelerations in axis z was about 32 % of that in axis x. Transversal acceleration in axis y in three cases lightly exceeded 0,5 g which is the value considered for cargo securing to protect the movement sidewards in rail transport. In general there was found out that transversal accelerations reach higher values in impact tests in front direction when there is no space near the front sidewall of wagon.

3. Functionality of monitoring units during the impact tests

The monitoring units which were used allow also recording of position and sending the automatic reports about detected accident situations. For purposes of these impact tests there were set to such initial level of acceleration for accident detection that all the impact tests should be evaluated as crashes. Monitoring unit A1 recorded all 10 impacts and 8 of them correctly evaluated and sent to provider`s information system. Few seconds before both impacts which were not correctly evaluated had occured other smaller acceleration. Unit A2 evaluated as crashes all 10 impacts, but in one case (Res F05) it also probably recorded other acceleration caused by obstacle on the track which the wagon passed through. Unit X1 placed on the impacted wagon recorded 9 of 10 observed impacts (only impact Rils R09 with low speed before impact missed) but only 5 of them were sent to provider`s information system as crashes. Unit X2 recorded all the all 10 impacts and 7 of them evaluated as crashes. Due to the impact tests were done at closed hall, positions of impacts were not very exact, differences between determined positions and real positions of impacts were from 50 to 200 m in almost all the cases. Also the ride direction before the shock was in several cases recorded incorrectly or not recorded.

4. Conclusions

In these impact tests the influence of wagon impacts on secured cargo consisting of coils of wire was observed. As more proper way of securing coils in upper layer can be considered their securing to wagon lashing points. Securing of cargo only with the neighbouring coils caused that the cargo moved, the manner of securing used in the first series of impact tests was considered unproper because, the coil in upper layer did not fulfil the crowding-out effect. Higher accelerations

in longitudinal axis were measured by measuring equipment placed in the level of buffers than by that placed higher on the wagon. For impact tests there were also used monitoring units usable for monitoring of transport and detection of accidents. Due to measuring in closed building, probably with not very good GPS signal receiving, the monitoring units did not reach such accuracy of position determination as it is usual when they are used on the roads or railways. The shocks during impacts were mostly detected correctly, but not in all cases were they correctly evaluated as accidents with sending the message about accident to provider`s information system. Reliability of accident evaluating was 75 %.

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An Overview of the Refrigeration Storage System of Polish Fishing Vessels

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Abstract. The characteristic of refrigeration storage systems which are common used in the polish fishing vessels is presented in this article. The main purpose of this paper is to describe the present state of the storage systems (including their efficiency and impact on the environment) and to show the possibilities of improvements. Generally, the refrigeration storage systems on the Baltic fishing vessels are used to maintain the fish temperature in the hold at 0 to -1oC. However, their operation is associated with significant costs. Therefore, it is important to apply reliable solutions with high efficiency, to ensure a high-quality product while minimizing costs and impact on the environment.

Keywords: energy usage, refrigeration storage systems, Baltic Sea, fishing, efficiency.

1 Introduction

The fish storage system's task is to reduce the temperature of the fish in the cargo area to the required level, regardless of external conditions. This is carried out mainly by the refrigeration system, in which heat is transferred from lower to a higher temperature with the supply of external energy. The transport of heat from the lower to the upper source may be achieved in a number of ways and using different physical phenomena. But, for the vast majority of fishing vessels of the Baltic fleet it is based on the vapour compression system. On individual fishing vessels the system is based solely on the ice brought from shore. Also descriptions of systems using absorption refrigeration equipment powered by waste heat from main engine can be found in the literature [1]. However, the practical application of such solutions is limited to individual units, often remaining in the state of research. Hence, the subjects of this article were limited to the vapour compression devices, regardless of whether they relate to air cooling, water in the RSW system or ice-makers.

The operation of refrigeration systems is associated with significant costs. Energy research of fishing vessels indicate a large share of the fishing storage system units in the overall energy balance. Therefore, it is vital to use reliable solutions with high efficiency, to ensure a high-quality product while minimizing costs and their influence on the environment.

Refrigeration storage systems used on fishing boats in the Baltic fleet are used mainly to maintain the temperature in the hold in the range of 0 to -1^{o}C. As already mentioned, the vast number of equipment used for this purpose is based on the vapour compression systems, which depending on the applied solutions provide: ice production, air cooling in the hold, or water cooling in the RSW system. The performance of refrigeration systems should be adjusted, in order to ensure adequate time to cool the fish put into the hold and guarantee a constant temperature of their storage, which is associated with the discharge of heat streams that flow inside the hold.

1. Refrigeration fish storage systems characteristics

Among fishing storage systems used for fishing vessels of the Polish Baltic fleet the following solutions can be met:

- Refrigerated Sea Water system – RSW;
- Cooling System based on ice produced on board from sea water or fresh water + cooling of the hold;
- Cooling system based on the ice brought from shore + cooling of the hold;
- Cooling System based exclusively on the ice supplied from shore.

In addition to these systems, a Chilled See Water (CSW) system might be encountered in practice.

Cooling with the use of ice, is the oldest and simplest system of fish storage. Ice as a source of cold, is designed to lower the temperature of the fish from the initial temperature down to approx. 0^{o}C, and to keep it at a constant level during the whole journey, regardless of external conditions. Hence, the performance of the system is determined by the weight of the ice necessary to achieve the refrigerant effect. The cooling capacity of the ice is connected with the temperature and the heat of its melting point r = 334 kJ/kg. In accordance with the FAO [5] in temperate climates the recommended ratio of the ice and the fish is 1: 1. The Ice can be brought from land or produced onboard. The usage of cargo space in this case depends on several factors, the most important being: the shape of ice, operating area and the size of the fish.

A modification of the ice-based storage system introduces air coolers to the hold. In this solution, the refrigeration appliance is designed to maintain a constant temperature in the hold during the trip – which compensates for heat flux inflowing from the environment. The introduction of air coolers can reduce the amount of ice needed, extend the duration of the voyage, and mainly, increase the amount of fish caught in relation to a system based exclusively on the ice.

In the RSW system the fish is cooled and stored in tanks with sea water. The ratio of the mass of fish to water is typically around 70% to 30% [2]. The temperature of the water and the fish is kept by the refrigerant within the limits of -1°C ÷ -0,5°C. The power of the refrigeration appliance is sufficient to cover the demand for "cold" at the highest heat loads occurring at the time of cooling water and fish. Cargo space in the RSW is usually divided into 3, 6 or 9 compartments (tanks) depending on the size of the vessel [3], [2]. Prior to the loading of the fish, the tanks are filled with sea water, which is initially cooled. The water cycle can be accomplished from the top or from the bottom of the tank. One of the advantages of RSW is a very good space usage. According to the literature the density of fish stored in this system ranges from 700-800 kg/m^3, while the fish stored in crates with ice is half less at only 300-400 kg/ m^3 [4].

In accordance with worldwide research, RSW system allows to obtain high-quality fish at a relatively low cost and small losses of raw material. In addition, RSW system ammonia R717 might be used as refrigerant, which has not only very good thermodynamic properties, but is also considered to be a clean, environmental friendly substance. Table 1 shows the comparison of the storage rates of selected systems.

Storage system	Storage Rate [kg_{fish}/m^3]
Ice storage system (in hold)	500 - 650
CSW	700
Ice storage system (in box)	300 - 350
RSW	800

Tab.1. The comparison of the storage rates of selected systems [5]

2. Polish Baltic fleet - the storage systems

Conducted studies have shown that on majority of the fishing vessels of the Polish Baltic fleet the storage system is based on ice and air coolers, the so-called “dry holds”. However, a growing group of companies introduces (or are planning to in the near future) a modernization of existing solutions and to adapts their vessels to the RSW system. Despite the high costs associated with the reconstruction of the hold and cooling installation, and the introduction of special vacuum pumps loading systems, this seems like the most reasonable way.

The examples of the storage systems usage in Polish fishing vessels have been shown in table 2.

	unit	Type of vessels									
		STOREM 4	**B-368**	**KB 275**	**KB-21 (M)**	**B25-s**	**B-410**	**B-280**	**B-280 (M)**	**K15**	**TR 14,5 "Parsęta"**
Vessel length	[m]	16,2	15,3	26,46	21,0	23,57	25,6	24,39	24,2	15	15
Breadth	[m]	5,2	5	8	6	6,5	7,2	7,39	7,39	6	5,5
Draft	[m]	2,19	1,87	3,28	2,3	2,56	3,3	3,27	3,6	2,8	3,25
High	[m]	2,6	2,44	4	3	3,38	3,5	3,65	3,4	3,14	
Bearing	[t]	27,4	10	124	60,98	72,41	97,1	120	143	68	40
Hold size / Fish mass	[m^3] / [t]		~25/		-/50	95/-	97,5 /-	~140/ -	~160/ -	70/-	~55/-
Storage system		Ice based	Ice based	Ice based	Ice based	RSW	RSW	RSW	RSW	Ice based	Ice based
Refrigerant		-	-	R407c	R507a	R717	R717	R507	R717	R507a	R507a
Cooling capacity / Ice generator capacity	[kW]/ [t/doba]	Ice from shore	Ice from shore	Don`t know	Don`t know	200	215	225	225	/2,5	Ice from shore
Cooling power	[kW]	-	-	~40	-	~70	~80	~80	~80	25	~10

Tab. 2. The characteristics of the storage systems in selected fishing vessles of the Polish Baltic fleet

The comparisons of the average amount of fish mass m_{fish}, which could be stored in 10 selected vessels, taking the type of storage system and hold size into account is presented in the figure 1.

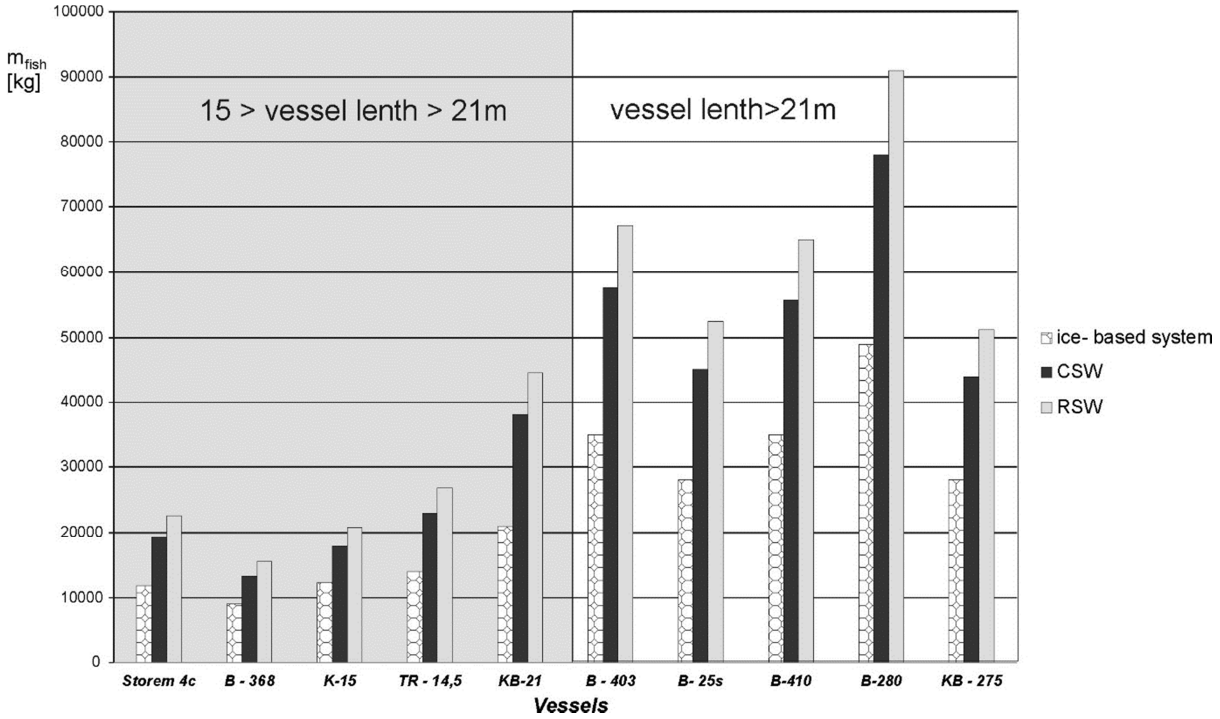

Fig.1. Comparison of the fish amount m_{fish} storage in selected systems

According to the fig. 1, the amount of fish stored in RSW system is almost twice as in the ice-based system (fish in the box). It means that the same types of vessels could have a different "fishing efficiency". Generally, the application of RSW system on the existing vessels needs: a new hold and load system and a new refrigeration system. However, the main limitation of that application on existing vessels is the cost of investment. Therefore, the CSW system could be an alternative. In this system, the fish are stored in the wet holds – the same as in RSW, but the ice is used to cool down the fish and water. The CSW system could use an existing ice generator or have the ice brought from shore in the smaller vessels.

The heat demand to cool down the 1 kg of fish in selected systems is presented in the figure 2. Heat demand of individual fish storage systems has been estimated basing on the energy balance, taking following into account:

The heat necessary to cool the fish from the initial temperature of the t_{in} to the temperature of storage t_2:

$$q_1 = m_f \cdot c_f(t_{in} - t_2) \ [kJ] \quad (1)$$

The heat necessary to cool water from the initial temperature of the t_{in} to the temperature of storage t_2(for RSW and CSW system):

$$q_2 = m_{water} \cdot c_w(t_{in} - t_2) \ [kJ] \quad (2)$$

The fish mass:

$$m_f = V \cdot \rho_f [kg] \quad (3)$$

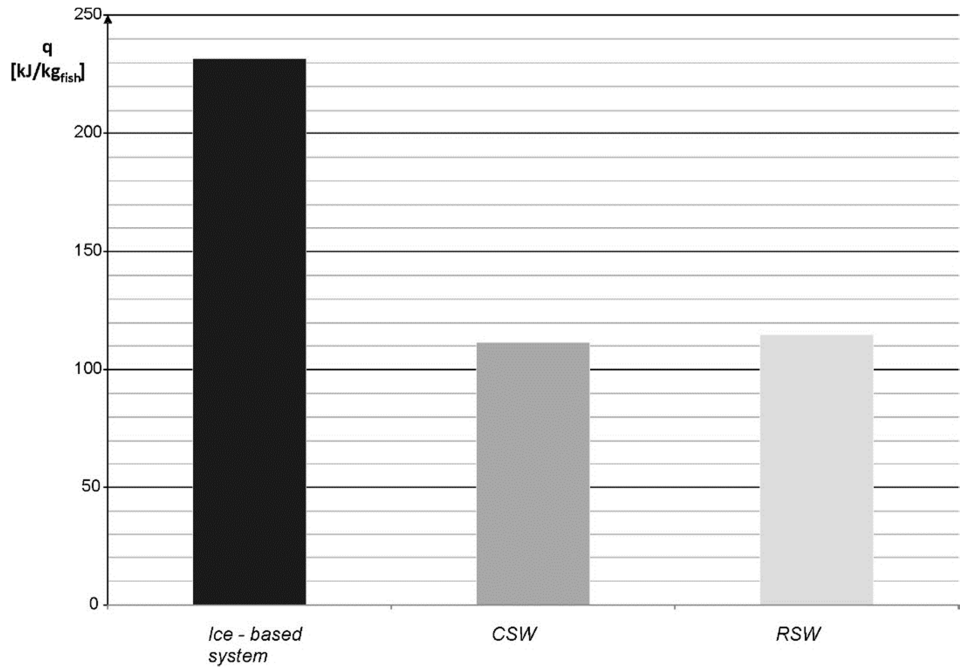

Fig.2. The demand for cold in 3 fish storage systems related to 1 kg of fish at a water temperature of 16°C

4 Conclusion

The RSW fish storage system guarantees the best space usage, while maintaining the high quality of the product. In addition, the heat demand in respect of 1 kg of fish is the lowest one. These characteristics are particularly important in the case of small fishing vessels, in which each cm^3 of loading space is precious and every penny counts. The RSW system has some alternative in CSW system, in which sea water is cooled with ice. However, due to the fact that the author has not met such a solution on the Polish fishing vessels, it was omitted.

For example, amongst 10 test vessels 4 were equipped with RSW, 1 with a system based on the ice brought from shore and air coolers, 3 with a system based on ice produced onboard and air coolers and 2 system was based exclusively on the ice. Therefore, basing on the simple energy analysis of the storage systems, and data acquired from the fishing vessels, it can be concluded that there is still a significant area of activities to improve their effectiveness and as a result, operating costs.

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