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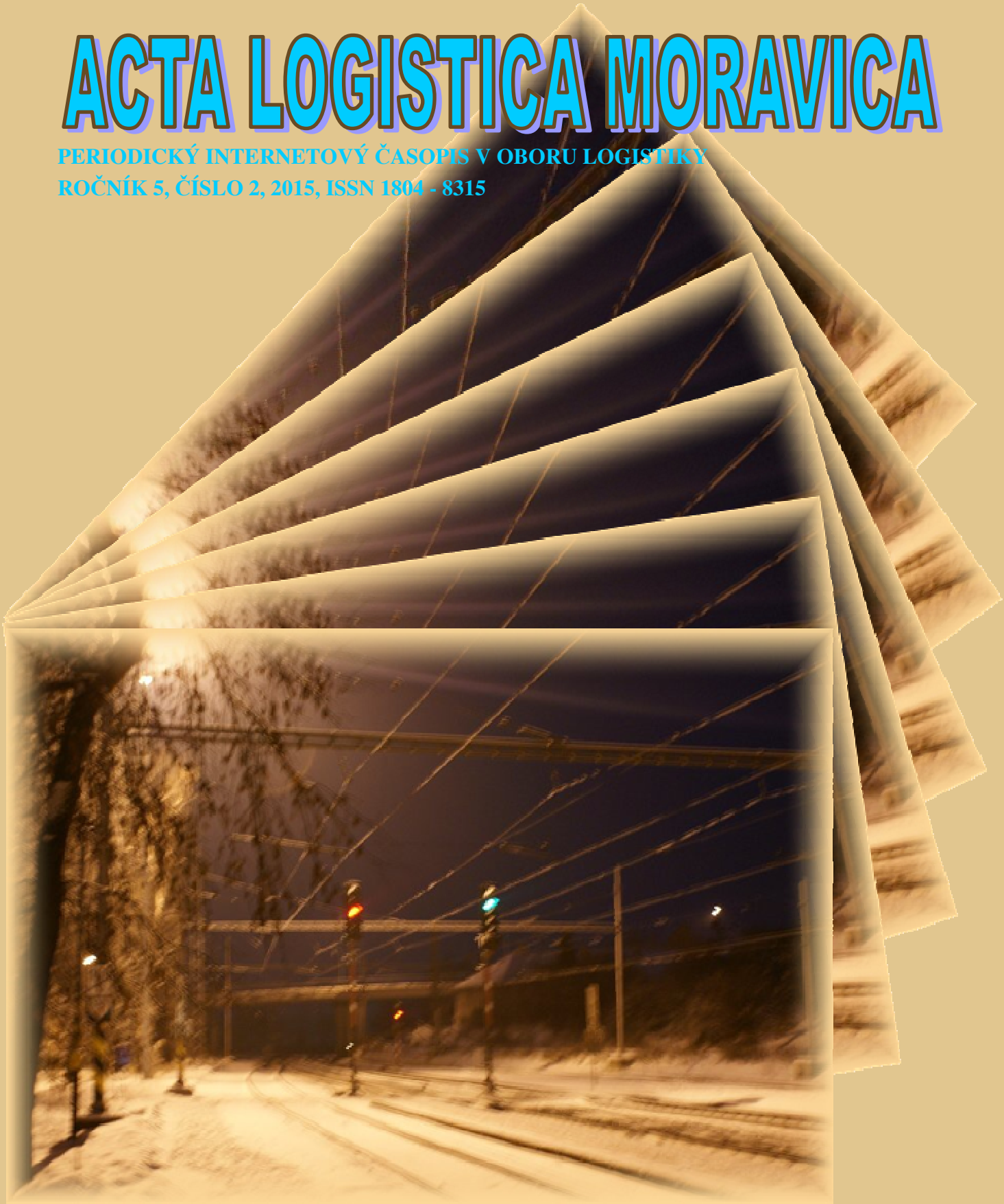

Vysoká škola logistiky o.p.s.

CONTENT

DESIGN OF INTERMODAL BUNDLING NETWORKS FROM/TO THE HINTERLAND OF THE CZECH REPUBLIC

MODELOVÁNÍ INTERMODÁLNÍCH SDRUŽOVACÍCH SÍTÍ Z/DO VNITROZEMÍ ČESKÉ REPUBLIKY

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Abstract

Containerization transport systems to the inland have led to the reconfiguration and synchronization liner service schedules and associated hinterland networks of the market players. Market players in the maritime transport have identified inland logistics as one of the most important areas still left to cut costs and to increase profitability. One of the appropriate solutions could be a so-called complex bundling. The complex bundling allows applying a large vehicle scale, high frequencies and high network connectivity, despite of restricted flow sizes. The challenge is to identify promising directions of intermodal network development and to compare bundling concepts for a different design of networks. The paper will analyse and optimise the development of inland service configuration and bundling in the Hamburg - Rotterdam range with focus to the container bundling in rail networks to the central Europe, especially to the Czech Republic.

Abstrakt

Kontejnerizace přepravních systémů do vnitrozemí vedla hráče na trhu k rekonfiguraci a synchronizaci tras a jízdních řádů ve spojení s vnitrozemskou sítí. Hráči v námořní dopravě identifikovaly vnitrozemskou logistiku jako jednu z nejdůležitějších oblastí, kde je stále možno snížit náklady a zvýšit rentabilitu. Jedním z vhodných řešení by mohlo být takzvané komplexní sdružování. Komplexní sdružování umožňuje zavedení odlišných frekvencí spojení, zvětšit ložnou kapacitu dopravních prostředku (vyšší zatížení) a zlepšit síťovou propojitelnost. Výzvou je určení slibných intermodálních sdružovacích sítí a srovnání sdružovacích konceptů pro odlišná nastavení sítí. Článek bude analyzovat a optimalizovat přepravu kontejnerů po železnici mezi vnitrozemím střední Evropy, především ČR a severomořskými přístavy.

Keywords

Logistics, intermodal transport, bundling, container, terminal

Klíčová slova

Logistika, kombinovaná doprava, svazkování, kontejner, terminál

INTRODUCTION

Regarding the economic performance of the member countries of the European Union,

fast, efficient and high-quality transport routes are the potential source for sustainable development of the society, and the way how to ensure growth of living standard at the same time. Besides numerous benefits, however, there is a wide range of negative phenomena that such development may bring. On one hand, they include jumps in the passenger transport volumes, in particular volumes of individual car transport, and on the other hand, there is a growing demand for the transfer of goods causing that the capacity of road networks (and railway networks in some cases) gets exhausted and, as a result, congestions arise. All this leads to diminished reliability of the transportation processes, extended transport times and increase in transport energy demand as well as environmental drawbacks and other negative impacts that affect the communities. In the freight transport, the so-called joint form of the transportation of goods with the use of multiple modes of transport, i.e. intermodal freight transport can be considered to be one of alternative options aiming to mitigate or resolve the said negative phenomena. It interlinks the road, railway and water (inland/maritime) transport in order to form a single harmonious whole for the purposes of mutual collaboration instead of presumed competition by harmonizing the advantages of each mode of transport to the benefit of the whole. This transport segment has been experiencing a turbulent development for several decades owing to the growth of the Asian markets and the exchange of goods with the use of containers as the unified transport units. There are, however, numerous problems and issues associated with such rapid development, which require prompt resolution. One of these issues is the transportation of containers by rail between the container terminals of the ports and those situated in the hinterland.

BUNDLING MODEL

The bundling (sometimes also referred to as consolidation) is, in general, a process of generating sufficient volume of freight flows, i.e. organizing transport units or load units into a single unit with the required level of services (Kreutzberger, 2010). The theoretical background of the term “bundling” dates back to the '90s, when it was used in many scientific publications and papers, and practical guides as well. There were several similar models set up in the past, which were aimed at bundling the freight flows in the intermodal transport, however, the vast majority of them has never been put into practice or was cancelled as early as in the initial stage of the implementation process. The main cause lied in the reluctance of the intermodal operators to transport containers between the terminals (both inland and seaport terminals) with the use of indirect trains. As a matter of fact, direct trains keep the freight costs at low levels, which the intermodal operators are forced to offer to be able to beat the competitors. Nevertheless, the operators have failed to realize so far what advantages the bundling model can bring to them. After the boom in the '90s, the bundling networks have experienced a renaissance in recent years again. The bundling model allows finding of intermodal solutions which are relevant to different situations and helps increase the competitiveness of the intermodal transport at the same time. The directional bundling is divided in two categories, namely the direct bundling and complex bundling. The direct bundling (hereinafter referred to as the direct connection) is the best solution for voluminous freight flows which allow loading the train with freight to meet the required level and frequency. The networks of direct connections, however, do not serve intermediate terminals, and therefore they feature shorter transport distances and lower costs in comparison with the complex bundling. For the low-volume flows, direct bundling is not convenient due to low loading of the trains, which results in higher freight costs per load unit (container), and therefore, the complex bundling should be used instead.

The complex bundling is an operation during which the goods with different places of origin (begin terminals) and (or) different places of destination (intermediate and (or) end terminals) are transported by the commonly used means of transport and transport units (containers in this particular case) during the whole route (or a part thereof). The principle of the complex bundling is used mainly where the size of the containerized freight flow is not sufficient enough for operating the direct connection between the begin terminal and the end terminal (see Fig 1). Fig. 1 presents in its first section a comparison of two trains going from terminal A or B to terminal C or D. Each of the trains is only partially loaded and goes directly from its begin to its end terminal (i.e. from A to C or from B to D, respectively). In this case, the trains do not make stops at any intermediate terminals, and therefore this is what we call the direct bundling. If the main part of their route is bundled or consolidated into a single train instead transporting containers in the direct trains, it is possible to reach higher capacity of the train (it results in a higher loading degree as shown in the middle section of Fig. 1) or the transport can be optimized by increasing the number of frequencies (see the right section of Fig. 1).

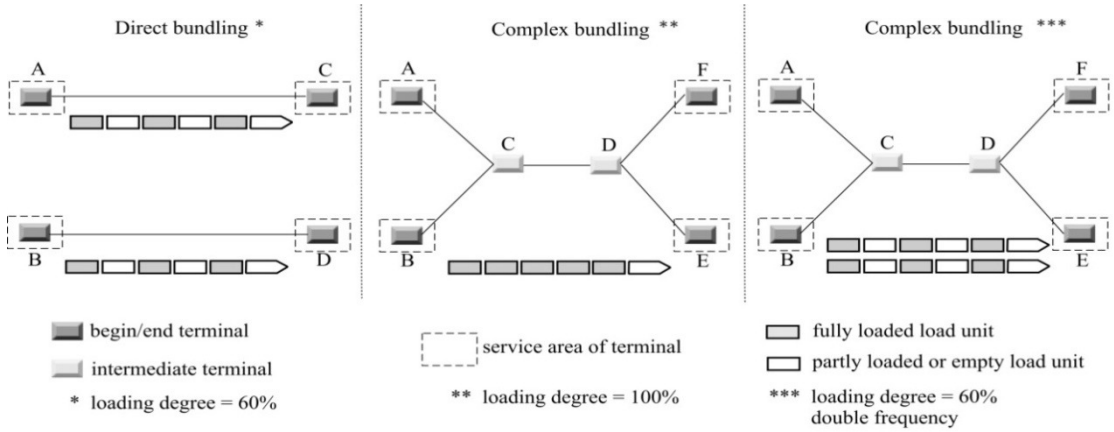


Fig. 1 Principle of the direct and complex bundling

The advantages of the complex bundling include:

- increase in the transport frequency, resulting in shorter waiting times of the containers in the begin terminal,
- increase in the number of final destinations (end terminals) from each begin terminal, which means that the serviced area can be expanded,
- reduced distance of pre- and post-haulage (=PPH), this applies to some specific cases,
- higher profitability due to higher loading degree of the transport units and load units,
- balancing the transhipment time at the terminal (reduced waiting times), this applies to some specific cases.

Nevertheless, the bundling model also has some disadvantages, which are:

- increase in the transhipment operations at intermediate terminals and increase in costs associated therewith; this can be handled by using an optimized transhipment technique for the transhipment of containers,
-

- increased transport distances compared to direct connection and increase in the total transport time (detour), which is not pertinent in every case,
- lower capacity/volume of the transport units on local routes of the networks (feeder routes), which is not pertinent in every case.

The bundling model uses different networks, in which the self-contained container trains move, see Fig. 2. These networks are the feeder networks (=F), line networks (=L) and the hub-and-spoke networks (=HS); direct bundling is designated as direct networks (=D). Each network has its specific features; they differ from each other in the number of main and local routes, number of intermediate terminals, etc. The D networks have the highest number of main routes, while the HS networks feature a medium number thereof and the remaining two bundling networks have only one route (connection). The D and HS networks consist of only main routes or parts thereof, on which the volume of trains between the begin terminal and the end terminal is constant in order to operate fully loaded trains. The F and L networks consist partially of local routes, on which the trains are shorter or have a lower loading degree (which may not be pertinent in every case). The D networks only have begin and end terminals and no intermediate terminals. The number of intermediate terminals is ranging from one for the HS networks (known as the hub) to two for the F networks (it is not necessarily the rule), and is variable for the L networks; it is, however, identical to the D networks as far as the number of transhipments is concerned. Every begin terminal and end terminal have a service area of their own, which means that the PPH is organized via road transport.

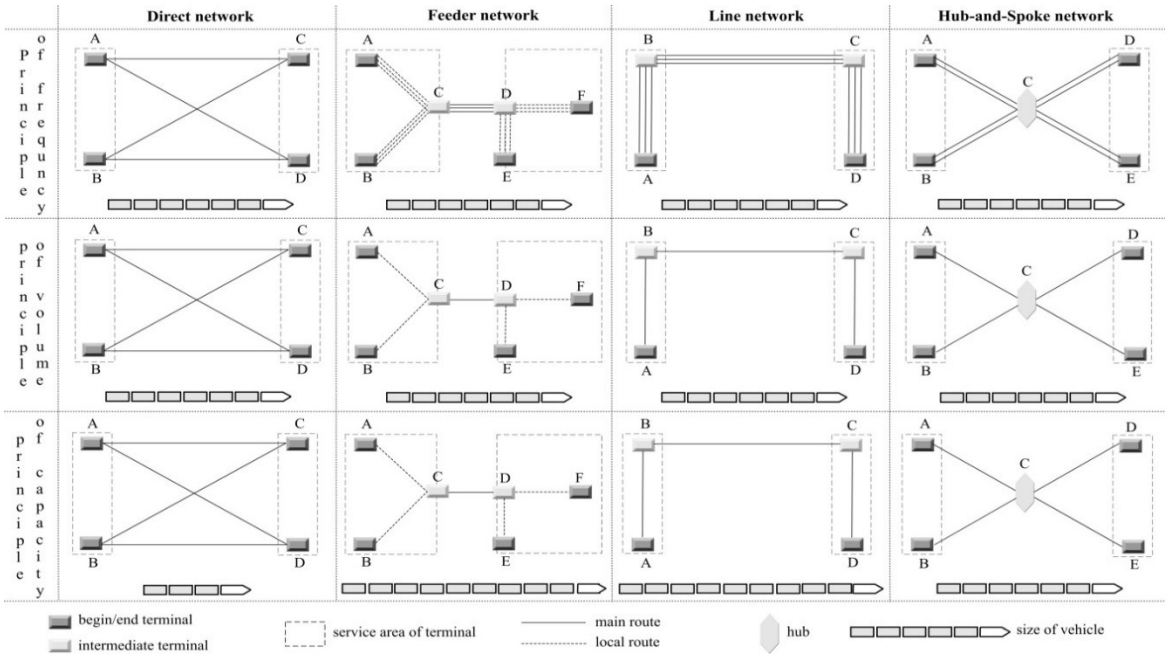


Fig. 2 Individual networks and bundling principles

PRINCIPLES OF THE BUNDLING MODEL

The heart of the bundling model are the so-called major variables, which primarily include the transported volume in the networks and number of connections as well as the size of transport units (trains) and number of frequencies. These interactions need to be differentiated in the bundling model and they can be collectively designated as the so-called

principles of bundling (Kreutzberger, 2008), see Fig. 2:

- the principle of transport frequency - the cargo volume passing through the network and the capacity of the transport unit is the same in all networks; the transport frequency is variable,
- the principle of network volume (size) - the cargo volume passing through the network and the capacity of the transport unit is the same in all networks; the transport frequency is variable,
- the principle of transport unit capacity (effect of operational measures) - the cargo volume passing through the network and the transport frequency is the same in all networks; the transport unit capacity is variable.

There is a quantitative relationship between the three principles, which can be called the bundling triangle. Any change in one of these three principles (entities) will cause that at least one other principle will be changed. The quantitative relationship depends on the choice of the bundling principle and the number of the begin and end terminals. The above three principles are also shown in Fig. 2 in the so-called directed and separated networks with 2 begin and 2 end terminals on each side of the network. Each line between the terminals signifies connection per time unit and indicates the frequency. The sum of the lines represents the network volume; the length of the transport unit displayed in each of the rectangles at the bottom represents the capacity of the transport unit, i.e. the volume of trains in each network. In the principle of frequency, the network volumes and the capacities of transport units are constant, i.e., the D network has a frequency of 1, the F and L network has a frequency of 3 for the main route, and the HS network has a frequency of 2, which means that the number of departures from the begin to the end terminals is in a ratio of 1:3.2. In the principle of network volume, the volumes are in a ratio of 4:1:2 (D, F/L and the remaining HS network) and feature identical transport frequencies and capacities of transport units in all bundling networks. In the principle of transport unit capacity, the capacities of transport units are in a ratio of 1:3:2 (D, F/L and the remaining HS network) based on the identical network volumes and frequencies in all bundling networks.

MATHEMATICAL FORMULATION OF THE BUNDLING MODEL

The major variables of the bundling model include volume transported in the network, number of frequencies per connection and transport unit capacity, and compared to the above mentioned bundling triangle the number of main routes has been additionally introduced as another variable. These variables are characterized by unavoidable and flexible quantitative relationship within the same period. This relationship is unavoidable in any network and its simplified formulation for the bundling networks is as follows. The capacity of transport unit (trains) C in TEU on the major route of the connection is equal to the volume transported in the network V_n in TEU divided by the number of main routes of the vehicles R_v and the number of frequencies of services per unit of time (F) (see formula 1), or analogically expressed as a quotient of the volume transported on the route V_r and the frequency F. The capacity of transport unit shall not exceed technical maximum C_{max}, which represents the maximum length of the train (600-700 m in Europe) and the maximum axle load.

In the top-to-bottom decomposition of the system, the capacity of the transport unit is as follows:

$$C = \frac{V_n}{R_v * F} = \frac{V_r}{F} \leq K_{max} \quad (1)$$

in which:

$R_v = N^2$ in D networks, 1 in F/L networks, N in HS networks (2)

In the bottom-to-top approach, the capacity of the transport unit is the product of the capacity C_{max} and the loading degree of the vehicle λ, see formulas 3 and 4.

$$C = C_{max} * \lambda \quad (3)$$

$$0 \leq \lambda \leq 1 \quad (4)$$

The above mentioned term "unavoidable relationship" means that if three of the four variables of the bundling model (C, V_n, F, R_v) are given, then the fourth of them is definitive. It also means that if the bundling options are compared, it is necessary to compensate the different number of the main routes in the bundling network by the value of at least one of the four variables. In such case, the aforementioned bundling triangle will change into a bundling square. The above mentioned term "flexible" refers to the fact that any of the bundling variables can be calculated at both the input and output. The choice of the variable is compensated by the number of the main routes R_v pertaining to the principle. In the frequency principle, the transported volumes and the capacities of transport unit in the compared bundling networks are identical and the number of frequencies per time unit F_B is dependent on the bundling and is varying (formula 5). The index $_B$ represents the value of pertinent variables in the bundling. In the network volume principle, the transport frequencies and the capacities of transport units are identical in all compared networks and require a network volume V_{nB} in TEU depending on the bundling, which is varying (formula 6). In the principle of transport unit capacity, the network volumes and the frequencies of services are identical in the compared networks; the capacity of the transport unit C_B in TEU is dependent on the bundling and is varying (formula 7).

The principle of frequency:

$$F_B = \frac{V_n}{R_v * C} \quad (5)$$

The principle of network volume:

$$V_{nB} = C * R_v * F \quad (6)$$

The principle of transport unit capacity:

$$C_B = \frac{V_n}{R_v * F}$$

ANALYSIS OF THE CURRENT STATUS IN THE CONTAINER TRANSPORT

The busiest ports in Europe are currently (2013) those situated on the coast of the North Sea or the Atlantic Ocean, which have a percentage share of more than 70% in the total transhipment volume of 100 million TEU (Bartošek and Marek, 2013). It means in practice that the major share in the transhipment of containers is divided among the large ports of Rotterdam, Antwerp, Hamburg and Bremerhaven. One of the factors that favour these ports and their container terminals is their technical maturity that enables berthing and transhipment of large container vessels, which require sufficient maximum draught, long quaysides and automated transhipment, etc. The shipping lines also tend to favour those ports, since they have their parent terminals there, and last but not least, various political pressures and lobbying also play an important role. The so-called H-R port area is used mainly as the

transport link between Asia and Europe in connection to the feeders to the Northern and Eastern Europe. During the service schedule (loop) of container vessels, the shipping lines always visit at least one of the said ports and further 3-5 regional ports in Europe. These container vessels may reach a capacity of up to 18,000 TEU (Marek and Bartošek, 2012). The mutual interaction between the seaports and hinterland is gaining intensity and plays an important role in the formation of logistics solutions of the providers of logistics services. The key factor that impacts on the competitiveness of the ports in the intermodal transport chain is primarily the ability of the ports to handle the flows of containers from/to the hinterland. The lack of interest in the reliability of transport to the hinterland was the reason that prompted the shipping lines and seaports to take over a more active role in the logistics chains. The choice of transport routes is strongly influenced by the conditions of transport to the hinterland and its reliability, which are the basic factors for the route selection process. The development of intermodal hinterland corridors has enabled deep penetration mainly due to shuttle trains and connection with the use of inland container vessels. The liberalization of railway transport that began in the '90s has proved to be a useful tool to increase the efficiency of the services provided on the corridors to the hinterland. Not only that the intermodality has stimulated the ports to expand in the hinterland, but also the hinterland itself has become within easy reach of the ports. The size of each serviced hinterland zone thus primarily depends on the number of frequencies of the services as well as the tariffs and services that are being offered.

Although the share of rail transport volume in the total transported volume has been declining since the 1970s (compared to road transport), this difference is not so much striking in the transportation of containers from/to inland. The transportation of containers by rail, or more precisely, intermodal transport was, particularly in the early stages, in the hands of state-owned carriers (until the end of the 1990s) who have been putting it out of their main area of interest over a long period of time. The leading role has been gradually taken over by the intermodal operators who have to face profitability issues in intermodal transport at their own risk. In the '90s, the intermodal rail connections based on the Hub and Spoke networks dominated, but they were gradually being abandoned due to liberalization of the railway transport in Europe and the growing volumes of transhipment operations in the ports. Presently, new connections are being introduced in the form of direct shuttle trains in the networks, in which the competitors have been already operating (example thereof is the introduction of shuttle trains by the intermodal operator TFG Transfracht between Hamburg and Lovosice in September 2013). Some intermodal operators, however, are gradually building their own Hub and Spoke network between the central hubs and local terminals (such Metrans with its hubs in Česká Třebová and Prague-Uhříněves and Rail Cargo Operator with its hub in Prague-Žižkov). The introduction of new railway connections and routes is very expensive, and because of strong competition between the intermodal operators and saturation of the market by road carriers, finding an optimized transport connection is a complicated task. Launching new services in the intermodal transport chain via railway connections in the major segment of transportation requires comprehensive analysis, involves higher costs and taking the risks to find appropriate critical transported volumes.

The transportation of containers by rail in the area of H-R ports is serviced mainly by direct shuttle trains. A large part of these shuttle trains operate between the ports and logistics terminals/hubs in the hinterland of Germany, Switzerland, France and Italy. As regards connection with Central Europe, the most widely expanded connections can be found especially to/from Czech Republic (Prague-Uhříněves, Česká Třebová, etc.), Poland (Poznaň, Slawków, etc.), Austria (Wells, Vienna, etc.) and Hungary (Budapest, Sopron, etc.) as well as

on the lines in the north-western direction (North Sea ports) and, to a lesser extent, in the direction towards the South (Adriatic ports), see Table 1.

Table 1 Selected shuttle trains between H-R ports and Central Europe (2014), (Selected intermodal operators, 2014)

Connection/Intermodal operator (Number of trains per week - export/import)	Metrans (GER)	Rail Cargo Operator (AUT/CZ)	Polzug (GER/PL)	TFG Transfracht (GER)	ERS Railways (DK/NL)
Hamburg - Prague Uhříněves	26/23				
Bremerhaven - Česká Třebová	4/10				
Rotterdam - Prague Uhříněves	5/5				
Koper - Dunajská Streda	14/14				
Hamburg – Prague Žižkov		10/10			
Koper - Bratislava		3/3			
Hamburg - Dabrowa			6/6		
Bremerhaven - Salzburg				3/3	
Hamburg - Lovosice				2/2	
Rotterdam - Poznaň					6/6

As regards the system of train connections used in the intermodal transport chain in the Central European space, it includes primarily the system of shuttle trains (direct connection) and the Hub-and-Spoke system that has been successfully applied in the transportation of containers between some terminals in the hinterland, which are used as node terminals/hubs. At shorter distances, feeder connections are also used to supply the large container terminals (hubs). The load flows are very intensive in these relations and the frequency of trains reaches at least one train per 24 hours. In other related directions, i.e. to other terminals within a country (continental transport), or to the neighbouring countries, the container flows are lower with train frequencies ranging from 2 to 5 trains per week. These connections can also be classified in some cases as feeder connection systems (an example thereof can be the connection operated by the Rail Cargo Operator between the terminal Prague-Žižkov and the terminals in Přerov and Paskov). In the Czech and Slovak Republics, the total transported volume between the European ports and the hinterland was around 847,000 TEU in 2013 (Hafen Hamburg Marketing, 2014), see Fig. 3. A noticeable trend in recent years is especially a successive decline in the Rotterdam port´s share, unchanged status of operations in the Hamburg port and increase in share of the ports of Bremerhaven and Koper. At present, the following companies can be considered to be fully fledged intermodal operators in the Czech Republic: Metrans, Rail Cargo Operator, Maersk Intermodal (former ERS Railways) and TFG Transfracht, see Fig. 3, which operate connection with the seaports as well as domestic connections.

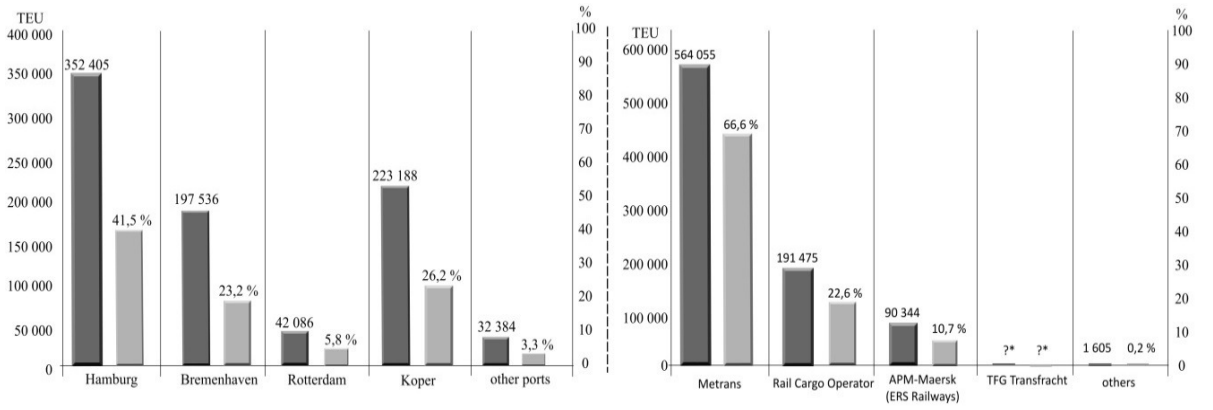


Fig. 3: Share of individual container transports between Czech/Slovakia and European ports 2013 (Hafen Hamburg Marketing, 2014)

IDENTIFICATION OF PROMISING BUNDLING NETWORKS

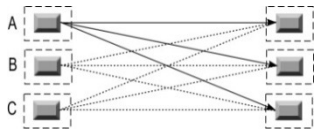
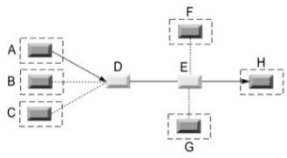
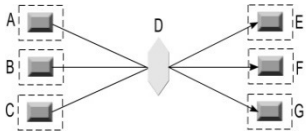
In order to be able to identify promising and suitable bundling networks, which can be applied in practice (simplified networks), it is necessary to make a comparison of the networks. The maximum possible number of terminals that can be bundled in practice is ranging from 2 to 4 terminals. The incorporated networks should be comparable in particular in the following aspects: the same number of the begin and end terminals, if possible, approximately identical distances between the terminals and a comparable transported volume between the begin and end terminals (the principle of volume) and/or comparable number services per begin terminal (the principle of frequency).

A simple comparison of the internal mechanisms between the bundling concepts in terms of the principles of frequency, volume and transport unit capacity, and identification of promising bundling networks are shown in Table 2. The table includes all bundling networks shown in Fig. 2. The trains in the presented networks have a capacity of 89 TEU, or only 44 TEU if the principle of transport unit capacity is applied. The loading degree is 90% (which means 80 TEU or 40 TEU per train respectively after conversion) and the train length is 600 m. These input data are fully verified since they come from the intermodal operators (Question forms for intermodal operators, 2014). The number of the begin terminals and end terminals in this comparison is either $N = 1$ or $N = 3$ on one side of the network. The number of main routes is in a ratio of 3:1/3:1/3:1 or 9:1:3. As regards the principle of volume, the annual volume of the network totals to 49,920 TEU; each begin terminal or end terminal has an annual transhipment volume of 16,640 TEU and approximately 12,480 TEU in the D networks. This amount of transportation enables the use of the following frequencies:

- once a week from each begin terminal or end terminal in the D network,
- twelve times a week from each begin or end terminal in the F and L network,
- four times a week from each begin terminal or end terminal in the HS network.

The above mentioned investigation clearly shows that the complex bundling enables offering of more frequented connections compared to the D networks, thus confirming the premises as mentioned in Section 2. In the frequency principle in Table 2, it is assumed that each begin terminal has a weekly frequency of 4 trains sent to each end terminal. In the D network, each destination must serve separately, i.e. there are 9 branches with a total annual volume of 149,760 TEU and annual volume of 49,920 TEU between the begin terminal and end terminal. In the F and L network, this volume amounts to 5,547 TEU, implying thus that a specific frequency can be achieved in the complex bundling with a relatively small number of begin terminals and end terminals in comparison with the D networks. In the HS network, terminals can be operated jointly, i.e. there are 3 branches, which show that the required volume between the begin terminal and end terminal amounts to 16,640 TEU per year. As regards the last principle (the principle of transport unit capacity), the frequencies and volumes of the networks are the same, the capacity of transport units, however, is different. The capacities of transport units for the D, F/L and HS networks differ in a ratio of 1:12:4. The quantitative relationship for the directed, separated and balanced networks can be expressed in general terms so that the capacity of transport units of the HS network is N multiple of the D network value, where N is the number of the begin terminals and end terminals on each side of the network, i.e. in parts of the major route of the other networks the capacity is N^2 of the D network.

Table 2 Promising bundling networks in terms of transport unit capacity, frequency and network volume principles

	Bundling network	The capacity of transport unit	Frequency per week	Connections x weeks	Transport volume
P		80 TEU 80 TEU 40 TEU 80 TEU 80 TEU 40 TEU	1x per week 4x per week 1x per week 1x per week 4x per week 1x per week	3x52 3x52 3x52 9x52 9x52 9x52	12 480 TEU 49 920 TEU 6 240 TEU 37 440 TEU 149 760 TEU 18 720 TEU
F		80 TEU 80 TEU 40 TEU 80 TEU 80 TEU 40 TEU	12x per week 4x per week 12x per week 12x per week 4x per week 12x per week	1/3x52 1/3x52 1/3x52 1x52 1x52 1x52	16 640 TEU 5 547 TEU 8 320 TEU 49 920 TEU 16 640 TEU 24 960 TEU
L		80 TEU 80 TEU 40 TEU 80 TEU 80 TEU 40 TEU	12x per week 4x per week 12x per week 12x per week 4x per week 12x per week	1/3x52 1/3x52 1/3x52 1x52 1x52 1x52	16 640 TEU 5 547 TEU 8 320 TEU 49 920 TEU 16 640 TEU 24 960 TEU
HS		80 TEU 80 TEU 40 TEU 80 TEU 80 TEU 40 TEU	1x per week 4x per week 4x per week 1x per week 4x per week 4x per week	1x52 1x52 1x52 3x52 3x52 3x52	4 160 TEU 16 640 TEU 8 320 TEU 12 480 TEU 49 920 TEU 24 960 TEU
					

It can be concluded from the above results that the comparison shows in some cases values that are not suitable for practical use. It can be stated within the validation of the results that the resulting volume corresponds to 80 TEU, i.e. the average loading of trains lies between 72 and 92 TEU, which corresponds to the standard volume transported by container train in the Czech Republic (Question forms of intermodal operators 2014). Also the annual transported volume of 49,920 TEU corresponds in practice in rough figures to the annual volume transported by the intermodal operator Rail Cargo Operator on the relation Prague - Bremerhaven. It is necessary to take into account the limitations of technical nature (max. capacity of the transport unit, maximum length of trains in the networks, clearance profiles, elevation profile of the route, etc.), which should be fully considered in the calculation when conducting an investigation in practice.

CONCLUSION

The bundling model offers good utilization potential mainly where the size of the containerized freight flow is not sufficient enough for operating the direct connection between the begin terminal and the end terminal. The model offers different networks (systems of train connections, i.e. bundling networks) for the transport purposes, in which the container trains can move. As far as the individual networks are concerned, important role is played by the bundling principles, upon which the frequency of services, volumes of networks and capacities of transport units are being changed. Each of the networks has different characteristics relating to the use, length of connections (detours), time-based evaluation,

number of transhipments in the intermediate terminals, etc. The best bundling concept for each particular situation is the one that establishes an optimum balance between the advantages and disadvantages of the complex bundling. There is, however, no best bundling concept that would be generally applicable, but only the one associated with specific network volumes and performance values. For example, option suitable for the defined volume and frequency, if the principle of network volume is applied, will be either the D network and HS network, or the F and L network. Additional costs which arise if complex bundling is used (not pertinent in every case) should be compensated by the benefits resulting from the introduction of new transhipment techniques. The optimum value will vary depending on the network, minimization of both the operational and logistics costs or maximized expansion of the serviced area. Nevertheless, it is obvious that larger capacities of transport units, higher frequencies or identical performance levels for lower transported volumes represent the extent and scope of economic benefits.

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ANALYSIS OF LOGISTICS ACTIVITIES DUE TO THE EMPLOYEES UTILIZATION

ANALÝZA LOGISTICKÝCH ČINNOSTÍ VZHLEDEM K VYUŽITÍ ZAMĚSTNANCŮ

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Abstract

The article deals with describing the various processes associated with the movement of freight by Škoda Auto, and the activities designed to optimize the employees in the process. The theoretical part of the LKW Control system is described here, telling what it means and on what basis it works. The second part uses theoretical knowledge in a practical solution to the issue at Škoda Auto. On the basis of this analysis the conclusion will present a proposal leading to further optimization of employees at Škoda Auto. With that there would be greater continuity process, and would save additional staff costs.

Abstrakt

Článek se zabývá popsáním jednotlivých procesů spojených s pohybem nákladní dopravy po Škoda Auto a následně jsou zde navrhnuty aktivity vedoucí k optimalizaci zaměstnanců v daném procesu. V teoretické části je zde popsán systém LKW Control, co to znamená a na jaké bázi funguje. V druhé části jsou použity teoretické poznatky v praktickém řešení dané problematiky ve společnosti Škoda Auto. Na základě provedené analýzy je v závěru práce uveden návrh vedoucí k další optimalizaci zaměstnanců ve společnosti Škoda Auto, díky které by došlo k větší plynulosti procesu, a ušetřily by se další náklady na zaměstnance.

Key words

Škoda Auto, Logistics system, LKW Control

Klíčová slova

Škoda auto, logistický systém, LKW Control

INTRODUCTION

Logistics is a relatively young field, which in recent years has evolved significantly. This is not only due to the globalization of world trade and the market as a whole, but also thanks to the development of information technology. Of course, a significant part is played by the customers, whom businesses have begun to focus on more. Companies are trying to prove, in any way, that their products are the most competitive. One of the areas in which it is possible to further reduce costs, is logistics. Logistics is a complex field, which in modern times extends into all areas of modern business. Each ingredient, material good or product must pass through the logistics chain before finally arriving at the consumer. The aim of every company is to make this process the most effective so the firm is able to minimize costs. This article deals with the movement of freight by Škoda Auto Inc. (Hereinafter referred to as Škoda Auto) and only for the Mladá Boleslav plant.

Škoda Auto is among the largest economic groups in the Czech Republic, engaged in the development, manufacturing and sale of automobiles, components, spare

parts and accessories for Skoda and service provision. Cars have been produced in Mladá Boleslav for more than a hundred years. Few automakers can refer to the continuous transfer of knowledge and experience in regards to long-term development and production. Since Škoda Auto has entered into the group, it has made a significant step forward. During that time, Škoda Auto more than tripled its production, significantly expanded its product portfolio, and greatly enhanced the brand image. It also built an extensive sales network of stores, a service network, and has successfully established itself in the international markets. Last year the company produced more than one million vehicles - more than ever before. As part of its growth strategy, the company expanded and modernized substantial part of its logistics. The entire logistics process involves 13 manufacturing facilities around the world from which Škoda brand cars are produced.

The aim is to describe the sub-processes associated with the movement of freight by Škoda Auto and the resulting optimization of company employees in the process. The work is divided into theoretical and practical parts. The theoretical part is based on available knowledge. At the beginning there are defined concepts related to the LKW Control system. The LKW Control System is used to control the truck after it has arrived in Škoda Auto. This is the concern about the system, which is designed to achieve the most efficient loading and unloading process with the aforementioned trucks. The practical part analyzes the process of what LKW Control has brought and optimized. The conclusion summarizes the results of the analysis and makes recommendations from the results of the analyses.

LKW CONTROL

LKW Control is an internal logistics system, which helps to drive trucks for Škoda Auto, with the exception of vehicles that do not take material production or have JIT parts. This system provides a user with an overview of the movement of trucks in the premises of the plant. The system is designed so that the loading or unloading of the truck is carried out as efficiently as possible. All vehicles entering the plant must be scheduled, either announced in a fixed window or announced in a pooled time window.

Announced in a fixed time window means to enter the carrier itself. This is the exact time of arrival of the LKW (truck) to Škoda Auto, where all necessary documents are processed. The plant is in Mladá Boleslav 13th gate. The advantage for carriers is that the car will be cleared at the time that has been set for it.

Announced in a pooled time windows meaning is different from *announced in fixed time window* because the time of arrival for check-carriers is assigned by the system. And then, depending on the carrier, whether it will be used yes or no.

After processing all data, drivers will be lent a telematics device. The telematics device consists of a mobile phone and GPS. The mobile phone allows for one-sided communication between the LKW Control system and the driver. Instruction is given to direct the driver to the point of unloading at Škoda Auto. Through GPS, all users of the LKW Control system have access to an overview of where the truck is in real time. In the event that a vehicle arrives at the 13th gate without a valid or hard pool time window, the dispatcher still has to process all documents and inform the driver that they will have to wait until it releases space for ramps warehouse. The LKW Control system ranks the unannounced vehicle as the last one, after checking all the announced trucks.

LKW Control system itself consists of the following applications:

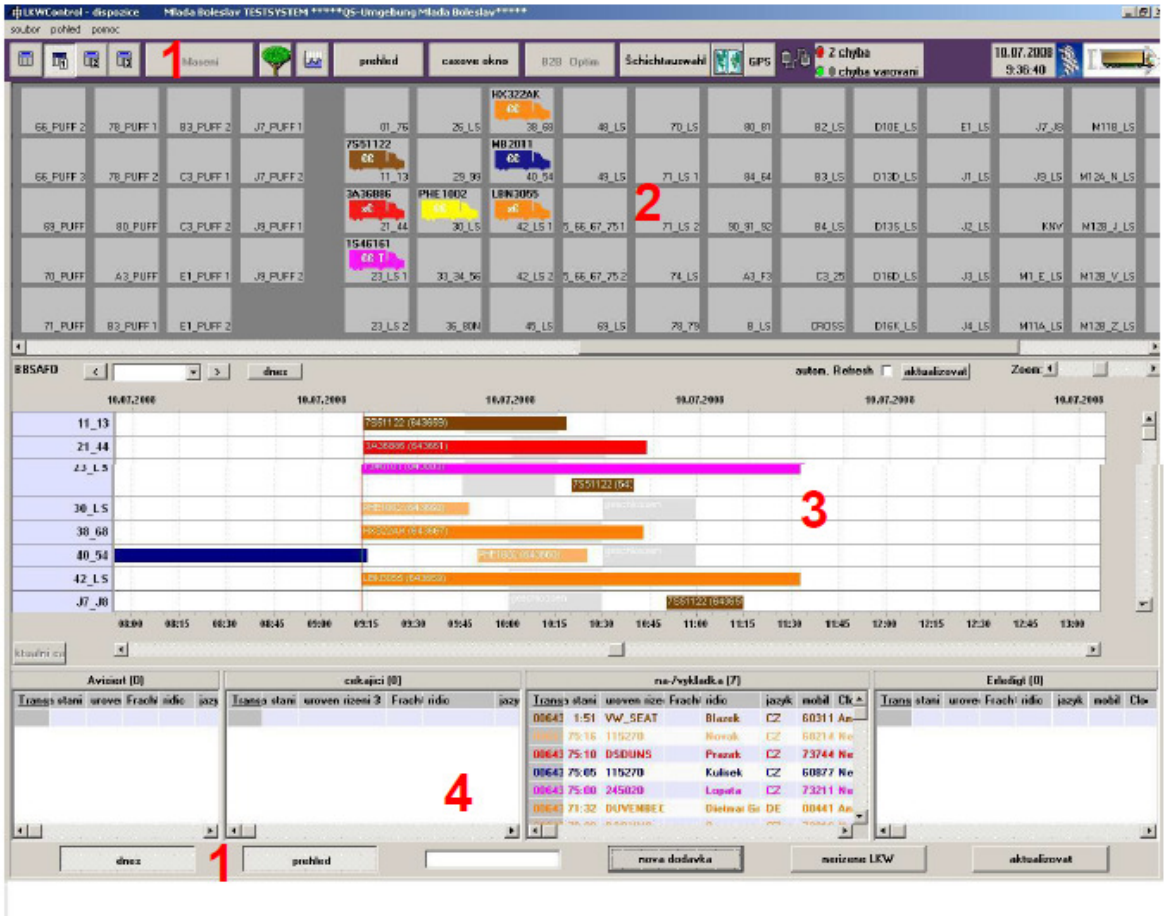
- Client management
- Client storage
- Master Data Editor
- B2B Portal
- Company protection

CLIENT MANAGEMENT

This application is designed primarily for dispatchers on the 13th gate. They accept and process documents (delivery) from a vendor that delivers drivers.

Guidance for the management of LKW

The driver shall inform the managing place on the 13th gate of their transport ID (This is the number of the transporter, which the system has created, in order to link all other information about driving). Thanks to that, the system searches LKW Control via search box. If the ID number is not known it may cause the need to search through forwarding, vendor registration marks, etc.



Source: Internal materials Škoda Auto – LKW control – příručka – řídící klient WOB

Fig. 1 Basic screen managing client

Basic Screen managing client

The primary screen for truck driving is divided into 4 main areas. These areas are distinguished from each other as each has a different mission (as seen in Figure 1).

1. Graphic display of processing zones and their current settings.
2. Graphic display of cast compensatory parking, unloading yard and managerial positions with all supplies (LKW) which are released from the control sites.
3. Grant-chart – this is a graphic representation of unloading yard with the estimated time of unloading or loading. This time is calculated automatically by the system based on the data from the master data and the input data entered by the carrier at booking time window in the B2B portal.
4. The last part displays all trucks in the plant. The time window, whether announced or pocket billiard is divided into the following four parts: The announced, waiting, loading / unloading, and discharged.

Splitting the screen can be set and stored individually for each user.

Check unannounced truck

If the driver arrives to control space and time window and is not reported such as its supplies can be divided into two kinds, namely: managed and unmanaged supply deliveries. Controlled deliveries are advised to be marked as planned deliveries and the managing client will control them within Skoda Auto. In this event such supplies are labeled as *new supply*. Subsequently, the LKW Control system lorry driver is ranked in last place in line for the entrance to the store. Uncontrolled supplies, which are controlled by the control client, are accepted as unmanaged. Their answer button is used *Uncontrolled LKW*, which is located on the main screen. Uncontrolled supply of Škoda Auto is a car that does not take production material. These include cars carrying supplies (food) waste, JIT, etc.

Delivery advise on managing client

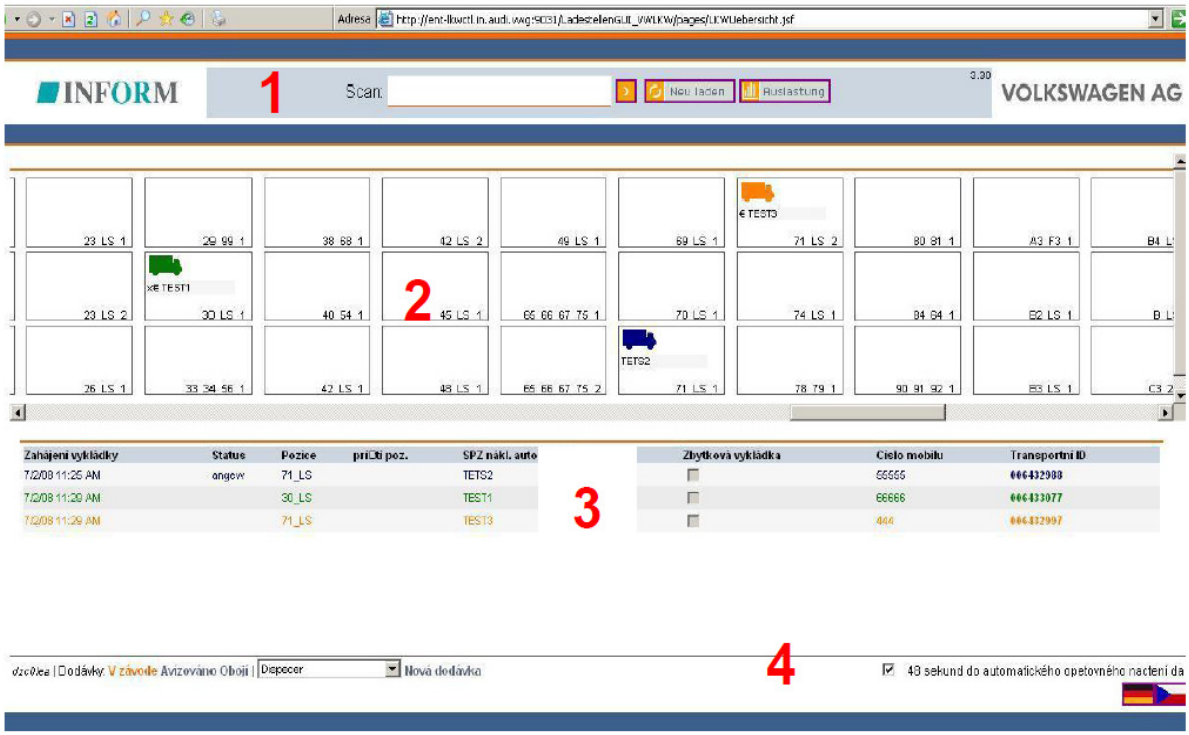
Whenever the worker enters any place of the control carrier time window in managing client. However, this is an emergency solution. It is used only when the carrier cannot, for technical, reasons open the B2B portal with the internet. The system allows an operator to specify a fixed time window or pocket billiard unloading.

CLIENT STORAGE

With this application the storekeeper has an overview of entry/departure trucks to and from the warehouse. His work in this system lies in the fact that he can start or stop the loading/unloading trucks. The storekeeper can see the trucks appear on a computer monitor at the time of their arrival at the car park in front of the store. They must then enter all the necessary steps manually, ie. *The beginning of loading/unloading* and *End of loading/unloading*. In addition, a warehouse worker completes an overview of the truck after

it has entered the plant. And checks the number of pallets that it carries to individual stores. The basic screen client storage is divided into four regions as shown in Figure 2:

1. Procurement search box deliveries by ID drive, display the workload of individual unloading yards (warehouses).
2. Graphic display of individual unloading yard.
3. Table with a list of supplies for each unloading yard.
4. Option selection displays vehicles (announced in the plant), language selection, updates, and workplace selection.



Source: Internal material Škoda Auto

Fig. 2 The main screen of the client storage

MASTER DATA EDITOR

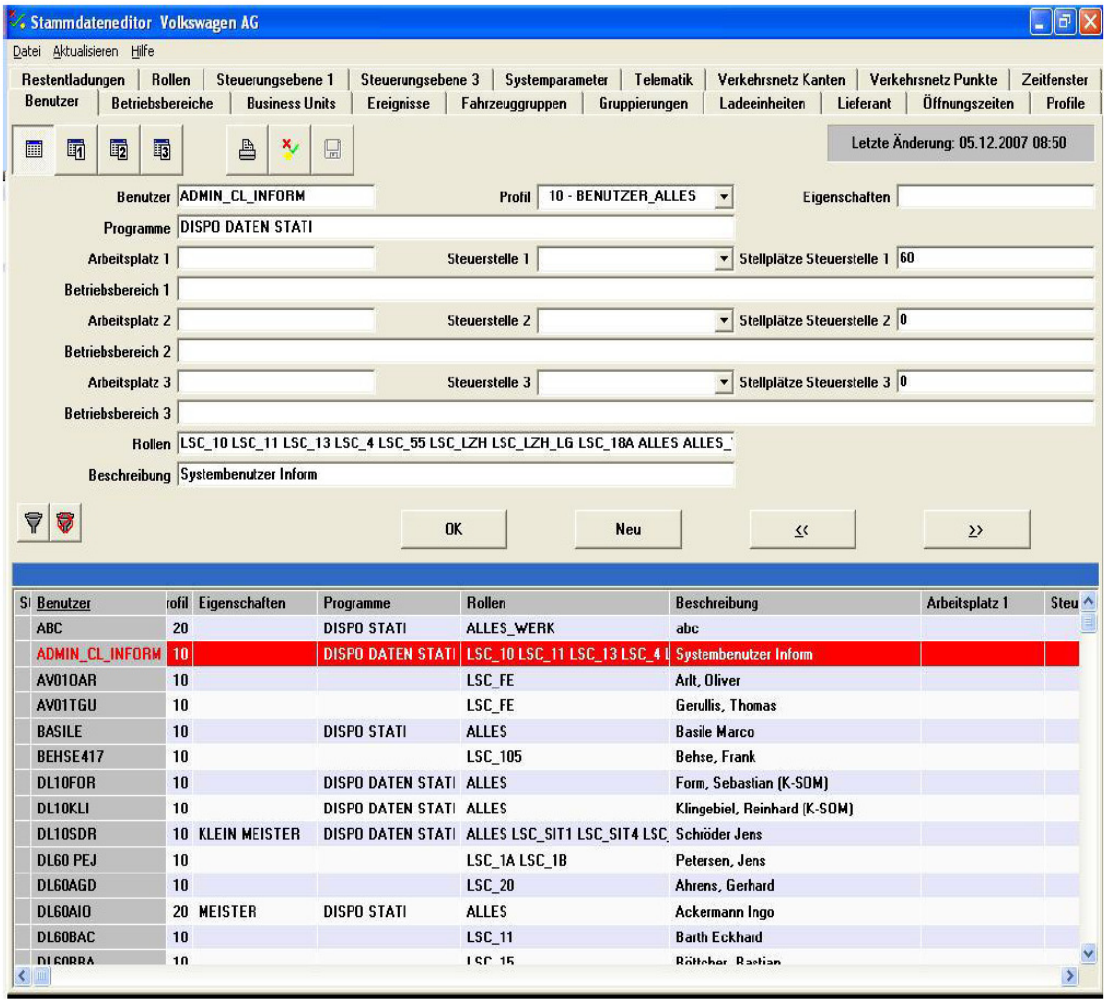
Master data editor contains all information about journeys made to Škoda Auto and the system users LKW Control. Using Master Data Editor one can make changes to master data, which are needed in the application of LKW Control. Master data editor is submitted depending on the master data for each master file of your card. Textbox can be selected to define and change master data and are located in the upper part of the card. At the bottom of the table is the current master data. In the middle centrally mounted buttons are located so that they are readily available for use in regards to data processing. (See Figure 3). If changes are made in the master data these changes must also be available in the LKW Control system. Use the *Update* button in the main menu to accomplish this.

B2B

This portal is used primarily for external controllers. You can book a time slot for loading or unloading. Each of the suppliers or shippers who deliver to the company Škoda Auto has your password and login name. The B2B portal announces the supplier of all supplies bound for Škoda Auto (Internal material Skoda Auto - příručka - LKW Control).

PROTECTION OF COMPANY

The main objective of this application is to provide an evidence of all cars that sweep or start from Škoda Auto (the 13th gate). At the time of arrival of the truck at the factory gate a worker enters the vehicle registration number. In the event that the car was in the plant during the last three months, a backup of all the information is completed (as the car itself, and drivers). If some information is not complete, the worker must complete it so the truck can then enter into the plant again. (Internal material Škoda Auto, a.s. – Příručka – závodová ochrana).



Source: Internal material Škoda Auto, a.s. – Příručka – LKW Control: Editor kmenových dat

Fig. 3 Main Screen Master Data

PROCESS CONTROL SYSTEM LKW

LKW Control system fulfills a number of functions, including: decision support, internal order planning and route optimization, automatic prioritization of trucks futures shipments, and influencing the allocation of time windows based on web interface, etc.

The process itself begins by creating temporal matrices. The basic matrix of time windows serves as a basis for entering daily time windows carriers. In this fundamental matrix time slots are permanently assigned for regulatory procedures and thus are not available for any subsequent assignments for other the arrival of trucks. The time window for them is always saved to the managing client and does not go directly to the warehouse. In case that it is the regular arrival at the control point, the base matrix can provide an accurate time window for the loading or unloading place. For this eventuality system offers LKW Control an auxiliary setting. When creating the basic matrix uses the same optimization algorithms as in the later (daily) calculate the optimum time window for the following day:

- After consultation with the carriers about the frequency and approximate arrival time window of the truck to a control point or at a loading / unloading area.
- The LKW Control transmits the time window of the truck‘s arrival to an Excel spreadsheet, to do all the optional loading / unloading at a specified point
- LKW Control system calculates the *optimal* plan for all allowable loading / unloading sites with regard to their capacity will be partially changed due to the arrival time of trucks.
- one can manually change subsequent matrices as defined in optimization.
- one can save and load the base matrix

Based on the difference in capacities of loading / unloading points and times booked by the time windows for control processes in the matrix, time windows that can transmit daily carriers can be shown. It can also provide spare capacity loading / unloading locations at certain times in the matrix not in the time window or the block.

Immediately after the driver passes the gatehouse, the vehicle is registered and receives the status of *arrival of the consignment.* At this point, a truck driver shall report to the appropriate place (by dispatcher VLO) 13th gate at Škoda Auto, and forward all documentation (delivery). The dispatcher will check all the documents and enter them into the system, at which point the vehicle gets the statute *arrived.* The driver will wait for the return of the processed delivery notes. From this moment compensation for downtime (ie. demurrage) begins, if the time window is not respected. Once the driver surrenders documents of the goods received from him against signature mobile phone with integrated GPS to the dispatcher he gets the statute *Ready to appeal*. After taking care of all paperwork, the driver leaves for waiting place to pass the time before the system gives him advice where to go. LKW Control System calculates the plan envisaged moving truck after the race and the time windows for individual stores, which have come (Internal material Škoda Auto, as - příručka-LKW control).

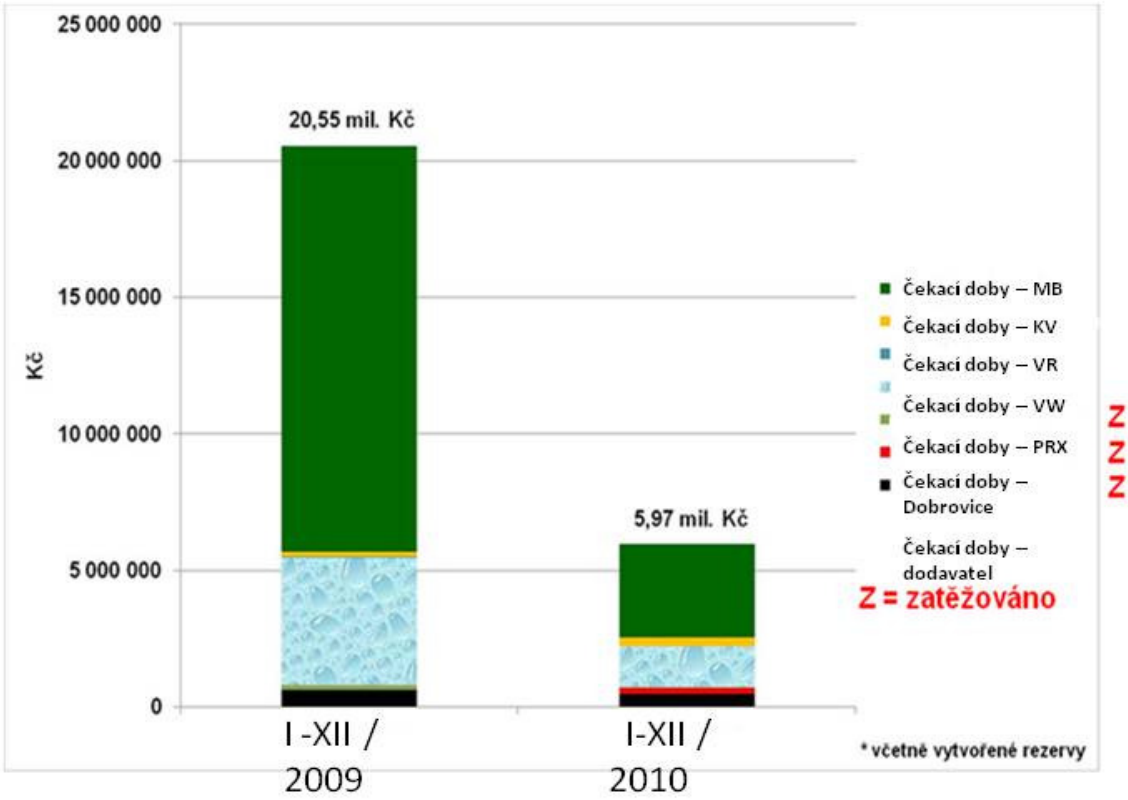
When the system sends control messages to the mobile phone with the first order, the lorry receives the status of *appe*al. The GPS system advises the driver that has arrived at the destination and thereby receives the status of *The Expectant parking / truck and place.* At the moment, unloading or loading, the truck gets status *loading / unloading*. Upon completion of loading or unloading the driver receives information from the system to the mobile phone

of another loading or unloading site or the need to move to a waiting car, which has arrived. The truck gets status *appeal*. In the event that no further loading or unloading positions should come for the driver the Control System LKW will withdraw the truck at the control point and the vehicle will receive the status,, Pending Out ".

The driver will then go to the control point (ie. the 13th gate), log off and return borrowed telematics device. Then he is assigned the status *unsubscribed* and after leaving the factory is set up at the gatehouse with the statute *draw out*.

THE BENEFITS AND OPTIMIZATION OF THE LKW CONTROL SYSTEM

Introduction and use of the LKW Control system are doubtlessly several major innovations in the management system of logistics processes. This system has helped, for example, to reduce waiting times of trucks.



Source: Internal material Škoda Auto

Fig. 4: Comparison of paid downtime before and after the introduction LKW Control

Figure No. 4 shows the situation before and after the introduction of the LKW Control. Thanks to a reduction of downtime cca14,58 mil. CZK within one year, the company saved almost 71% of the original amount in all factories in the Czech Republic. The plant itself in Mladá Boleslav has saved almost 80% of the original amount.

In addition to reducing costs LKW Controls has helped to simplify the work of employees, to utilize cargo spaces, and collect information on all trucks in Škoda Auto. These benefits are not only for the company itself, but also for carriers and forwarders from external companies who have an opportunity for B2B Internet portal to help manage their trucks. To the process involves clerks, and managing the loading sites and management of material points. The whole system optimizes and confirms the time windows online, in case there is any intervention at any stage of unloading or loading. The system has balanced the workload not only at the 13th gate, but also at individual stores. Each day, hundreds of trucks arrive at Skoda Auto, more than half of them carrying material. It would be impossible to manage the workload without the LKW Control system. Such efficiency and optimization is only possible with a specialized system like this one.

Another benefit is the ability to determine priorities for critical supplies. Called Engpass (production logistics, the term refers to endangered, critical material). Holders, who have an overview of critical material together with suppliers, organize special trips with critical material. Such a vehicle, which is marked Engpass is preferably controlled right from the moment as it arrives at the 13th gate. Available for these types of supplies exhibit ID drive and have so accurate view of how the vehicle is driven.

Furthermore, LKW Control enables reporting, i.e. obtaining data or information for further analysis or evaluation. These acquired results of the analyzes show the reducing of costs, streamlining of work, hard work loading and unloading of individual departments, shifts, etc. This is seen to occur to return the initial investment by the company in the real system LKW Control.

In this process, however, there are also some disadvantages. One is the instability of the system. If congestion occurs, prolonged response or may even system failure may occur. In this case, it is necessary to go into emergency mode. Records of all data necessary for controlling the movement of trucks to ensure the manual way. This is not only annoying, but it also means more work for all workers and a reduction of the flexibility of moving trucks.

Throughout the process, the logistics flow is to achieve maximum optimization of employees. However, the process can be further optimized to reduce costs and time that is necessary for the purposes of transporting raw materials or in the race. This applies particularly to the optimization of workers at the 13th gate where my terms in modern times leads to unnecessary manual administration. And, as a result, more downtime for the trucks.

The proposal would display the fact that the proceedings were trucks from suppliers. If the supplier itself had bought a telematics device that was connected with the system LKW Control (Namely that suppliers and freight forwarders have a unified program for system LKW Control on data transfer). This would have eliminated manual entry of telematics devices to the system LKW Control and any agenda that precedes it with the transfer and repatriation. In addition, the failure to optimize personnel at 13th gate, another advantage would be even smoother ride, the possibility of tracking material from the supplier to the factory Škoda Auto. The path of the truck itself would lead directly from the supplier to the plant, without having to delay the processing of any documentation. This would result in a total saving of 18 minutes downtime. 3 minutes, on execution of necessary documentation and the delivery of devices, and 15 minutes on parking and attendance back and forth to the 13th gate.

The idea for the study of materials, is the only one that did not challenge me. The group itself has a Quick Check system that allows truck driving just from the supplier

CONCLUSION

This article deals with the movement of freight by Škoda Auto. The aim was to describe the sub-processes associated with the movement of freight by Škoda Auto and the resulting optimization of employees in the process.

The article is divided into theoretical and practical parts. The very theory based of theoretical sources of logistics. The first chapter deals with the internal system LKW Control. This is a logistics system that helps manage trucks from Škoda Auto except for trucks that do not take material production or have JIT parts. This system was introduced in order to achieve the most effective and efficient loading and unloading processes. The aim of this system is not only smooth loading and unloading, but also the optimization of all costs associated with the truck.

The main part is the analysis by logistic flows for trucks and explanation of the process LKW Control in real-time with benefits. On the basis of the product design, which leads to a reduction of employees. The most important benefit of the introduction of this system was to reduce the waiting times of trucks, thereby reducing down time. The company Škoda Auto has an overview the workload of individual jobs for unloading and loading, and thus can decrease staff on the Managing sites and warehouse locations.

Recommendation concerns the further optimization of workers at the 13th gate, where there unnecessary administrative manual transmission and telematics devices. My suggestion firm advises drive trucks from the supplier to buy a telematics device at his own expense. This would be connected with the LKW Control. This would allow the steps of returning the telematics device at gate 13 to be eliminated and all agendas related to delivery notes, could be sent electronically, cutting the entire process of loading/unloading by 18 minutes. In addition, there would be more fluid rides and monitoring of deliveries from suppliers to Škoda Auto. Through extensive amounts of research I have learned that I am not the only one to propose similar systems. This idea of the LKW Control is not a new one, however I have also proposed some ideas that are my own. The company itself should include a similar process in future plans. In addition to the proposal, I have not found another possible route, where in the logistics process to save manpower, since the process is almost entirely automated with minimal human factor.

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WASTE SEPARATION IN VELKÝ ÚJEZD IN THE CONTEXT OF ECONOMICS

SEPARACE ODPADŮ V MĚSTYSI VELKÝ ÚJEZD V EKONOMICKÝCH SOUVISLOSTECH

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Abstract

The paper deals with waste management as a part of the reverse logistics. The aim is to analyse relations between costs and income regarding waste management in the small town of Velký Újezd. The information from annual reposts and bookkeeping of the town from 2004 and 2014 are used as important sources. The methods used are comparison and the best judgement.

Abstrakt

Práce pojednává o odpadovém hospodářství jako součásti reverzní logistiky. Cílem je analyzovat souvislosti mezi náklady na odpadové hospodářství v městysi Velký Újezd a příjmy z tříděného odpadu, které plynou městysi zpět. Pro práci budou použity informace z ročních hlášení a účetnictví městyse Velký Újezd z let 2004 a 2014. Mezi použité metody patří srovnání a kvalifikovaný odhad.

Key words

Low on Waste, separation, waste, waste management, reverse logistics, Velký Újezd

Klíčová slova

Zákon o odpadech, separace, odpad, odpadové hospodářství, reverzní logistika, Velký Újezd

INTRODUCTION

Waste - costs for someone, income for others. The essential question is, if it is possible to find the balance in between. The amount of waste has grown rapidly in the last 50 years. Luckily also approaches how to deal with waste develop and are successful in most developed countries.

The basic unit where waste has its origin is a household. One of the important task for municipalities is to choose carefully the approach to the waste management. Ten years is an ideal time to compare the attitudes, costs or incomes regarding waste management.

REVERSE LOGISTICS

When talking about waste, let's first introduce a wider topics of logistics, esp. reverse logistics. Every single item, product, ware or object (we can use many words to describe) has

it place of origin, its way of production, transport, utilization or consumption. People have benefit from products or services. Here we talk about logistics in a very simple way. The time of benefit differs with each product. When the time is over, when we do not use it any-more, then the product should go from the point of consumption back to the point of origin. Here we talk about reverse logistics.

According to Rogers and Tibben-Lembke reverse logistics is "*The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal."(Rogers a spol., 1998).*

People in general are aware about some kinds of products that go backwards – electrical equipment such as televisions, refrigerators, mobile phones of batteries which we carry back to the place we bought or similar. Waste from our households cannot be brought back to where we bought it. But we all use elements of reverse logistics if we separate waste.

WASTE MANAGEMENT AS A PART OF REVERSE LOGISTICS

Waste management is essential in our society of 21st century. There are countries that separate high percentage of waste, there are countries that do not separate at all. Unfortunately pictures showing waste at beaches e.g. in Hawaii can also be found. Hawaii is considered as a paradise but the Pacific ocean brings the waste to this place.

The U.S. Army – Hawaii states at its website[1]: *„Reduce waste... If not you, WHO? Before making a purchase, ask yourself if you need to buy the goods or materials, or if you are buying more than you need. The best way to reduce waste is not to produce it in the first place!"*[2]

PRODUCTION VS. CONSUMPTION

Let´s think about the status quo. Do we consume what is produced or do we produce what consumers need or just want? More and more waste is produced, thus more energy is needed to produce waste, and then, even more energy is needed to destroy or reuse the waste again. Here the economics starts to play its role. The fight of ecology and economics is a never-ending story and there cannot be only one winner. The key players in the field of package production should take care about the environments much more.

LAW ON WASTE

According to the § 4 of the Law No 185/2001 Sb. on Waste, the **waste management** is *„activity focused on waste prevention, management of waste and after-care of the place where waste is stored permanently, and on control of these activities"*[3], and **waste recycling**

1 USAG-HI's technical environmental liaison between the state and federal regulatory agencies, the Hawaiian communities and special interest groups. (http://www.garrison.hawaii.army.mil/sustainability/SolidWaste.aspx)

2 *Reduce Waste, Recycle More!* Retrieved from: http://www.garrison.hawaii.army.mil/sustainability/SolidWaste.aspx, [cit. 5. 4. 2015]

3 Law No 185/2001 Sb. on Waste, § 4

is stated as *„any way to use the waste, which the waste is reprocessed into products, materials or substances for the original or other purposes of their use, including reprocessing of organic materials; waste recycling is not an energy recovery and processing into products, materials or substances used as fuel or backfield waste“*[4].

Let's look at the waste hierarchy into the law again, § 9a. In terms of waste management, the following waste hierarchy must be followed:

a) waste prevention

b) preparing for re-use

c) recycling

d) other recovery of waste, e.g. for energetic purposes

e) disposal of waste

The goal No 1 is waste prevention. What every single person can do is to buy products packed in paper, glass or in no harmful materials. Here the producers play an important role. And economics fights with ecology again. Imagine just some kinds of chocolates, teas or detergents packed in two or three separated packages. Some products have much bigger package than needed. Here is one of the possible ways for waste prevention.

THE TOWN OF VELKÝ ÚJEZD

The town of Velký Újezd is located between Olomouc and Lipník nad Bčvou, on the foothill of Oderské vrchy. The altitude is 371 m. The river Odra has its source 6 km from the centre of Velký Újezd.

It may be interesting to mention famous natives. Jaroslav Švarc, one of the seven parachutes, who died in Gorazd church in the Ressel street in Prague after the **assassination on Heydrich in 1942. František Nechvátal, a poet of the Nezval generation or academic sculptor Vladimír Navrátil.**

Nowadays there live 1311 inhabitants in Velký Újezd (1. 4. 2015) and people keep finding their new homes here.

WASTE MANAGEMENT AND WASTE SEPARATION IN VELKÝ ÚJEZD

The town of Velký Újezd follows the Regulation about establishing a system of collection, transport, separation, use and disposal of urban waste and construction waste management in the area of Velký Újezd. The Regulation is based on the Law on Waste No. 185/2001. The waste separation works in cooperation with the company EKO-KOM.

According to the mentioned Regulation (up-to-date version valid since April 1st

4 Law No 185/2001 Sb. on Waste, § 4

2015), the waste is separated into 10 components. The following table compares the components that were separated in 2004, 2014 and are separated now.

Tab. 1.: Waste separation – components in time

TYPE OF WASTE / YEAR	2004	2014	01.04.2015
paper	✔	✔	✔
plastics	✔	✔	✔
glass (all types)	✔		
glass – white		✔	✔
glass – colour		✔	✔
bulky waste	✔	✔	✔
hazardous waste	✔	✔	✔
cemetry waste	✔	✔	✔
residual waste	✔	✔	✔
bio waste			✔
metals			✔

source: onw, according to the Regulations of waste, Velký Újezd

The Regulation also describes:

- what type of waste belongs to which container or sack
- where the containers are located
- what to put to the particular containers or sacks, what does not belong there
- when the transport happens
- bulky waste management
- construction waste management
- waste of the cemetery and its disposal

The waste management in Velký Újezd uses containers and sacks, as described above. All residents of Velký Újezd get the sacks for free – yellow one for plastics and blue one for paper. Every fortnight the collection and transport is realised by the Remit company. People just prepare the sacks to the front of their houses. Collection and transport of the residual waste work the same, people place their own waste bins in front of their houses every other fortnight.

Fig. 1.: Sacks for plastics and paper ready for collection

source: own

White glass, colour glass, metals and bio waste belong to the containers (white, green, grey and brown ones). The bio waste is processed by local farmer. There are 5 containers for both types of glasses, one for metal and 20 for bio waste.

Bulky and hazardous waste is being collected and transported twice a year in announced day and time in 5 places all over the town.

One container for used clothes, shoes and toys in placed in the centre of Velký Újezd. Also the charity works here to collect the needless stuff.

Fig. 2.: Containers for glasses, clothes and metal

source: own

Fig. 3.: Container for bio waste

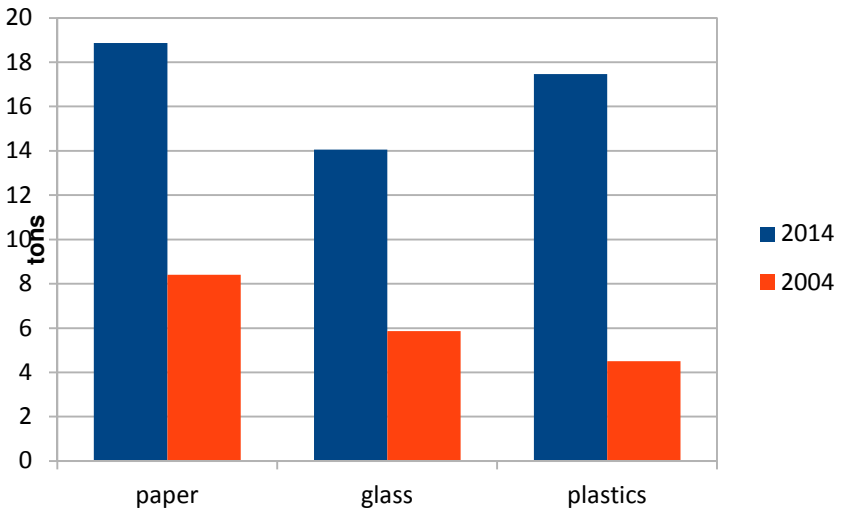
source: own

The following tables and graph show what type of waste was separated and in what amount (numbers in tons) in the years 2014 and 2004. As we can see in the table, the last 10 years has witnessed a speedy progress in waste separation.

YEAR	paper	glass	plastics	tyres	liquid chemicals	batteries	non-biodegradable waste	separation in total
2014	18,87	14,06	17,46	0,42	0,27	0,07	4,94	**56,09**
2004	8,4	5,86	4,51	N/A				**18,77**

Tab. 2.: Separated waste – amounts in tons (comparison 2014 and 2004)

source: own, on the basis of the Reports



Tab. 3.: Waste separation in numbers

YEAR	number of residents	separation per resident / t	separation per resident / kg	percentage of separation
2014	1281	0,0438	**43,79**	18,2
2004	1068	0,0176	17,57	10,3

source: own, on the basis of the Reports

According to the EKO-KOM company, the separation per resident in the Czech Republic in 2013 was 39,7 kg in average[5]. (Numbers for 2014 are not available yet.) Residents from Velký Újezd have separated more (in 2014), 43,79 kg per resident.

Regarding the residual waste the best numbers in ecological view reach the Plzeňský region with 231 kg of residual waste per resident (Středočeský 372 kg). To highlight the best region regarding the separated waste is a bit troublesome. You never know, if the lower number means the lower consumption of waste in general (which is a positive aspect) or lower percentage of separation. This must be evaluated in wider context.

In the competition „For a ceramic waste bin 2014“ Veký Újezd took the fifth place. It wast the eight place in 2013. Here is the list of the winners in 3rd category - towns. (1st category – villages up to 500 inhabitants. 2nd category – villages from 500 inhabitants.)[6]

1. Jeseník
2. Olomouc
3. Litovel
4. Hanušovice
5. Velký Újezd
6. Kojetín
7. Zábřeh
8. Konice
9. Prostějov
10. Velká Bystřice

The table No 4 shows how much kilograms of paper, glass (white and colour in total) plastics and residual waste was produced in Velký Újezd per one resident in 2014.

Tab. 4.: Separation per resident – basic elements and residual waste

separated waste in 2014	paper	glass	plastics	residual waste
kg per resident	14,73	10,98	13,63	195,9

source: own, on the basis of the Reports

The volume of waste produced by one resident will be presented at the particular household. The method of the best judgement was used. There are of course differences between households or single persons regarding waste production and possibilities of

5 *Přehled dosahovaných výsledků*. Retrived from: http://www.ekokom.cz/cz/ostatni/vysledky-systemu/vyrocni-shrnuti, [cit. 5. 4. 2015]

6 *O keramickou popelnici 2014*. Retrived from: http://www.jaksetociodpady.cz/odpady/index.php?page=2-o-keramickou-popelnici-2014, [cit. 5. 4. 2015]

separation. People in villages e.g. have different possibilities in bio waste processing than people in towns.

The given households has the following features:

- 3 adults and 1 child (80 % of residual waste are infant nappies)
- heating by fireplace (usual paper and magazines are burnt there)
- possibility of bio waste processing

Tab. 5a.: Separation per resident – example of particular family (best judgement)

WASTE TYPE	volume of the waste bin/ sack (l)	number of collections	4 people / year (l)	1 person / year (l)	1 person / year (kg)
residual waste	110	12	1320	330	**150**
plastics	120	12	1440	360	**6**

source: own

Tab. 5b.: Separation per resident – example of particular family (best judgement)

WASTE TYPE	weight (kg)	number of collections	4 people / year (kg)	1 person / year (kg)
paper	4	2	8	**2**
glass	10	4	40	**10**

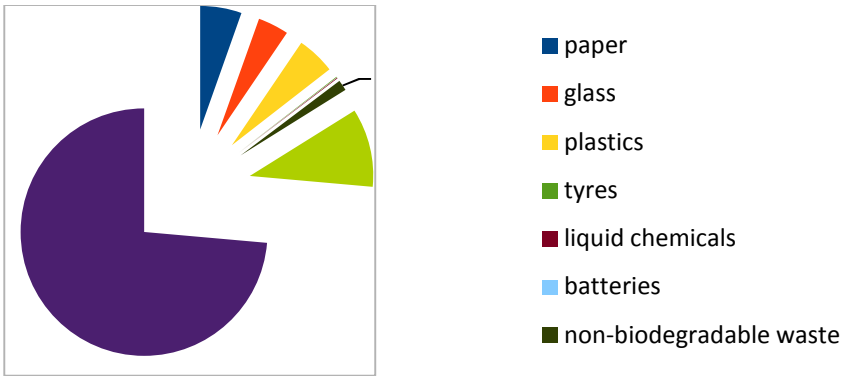
source: own

The table No 6 and the following graph show the diversification of waste in Velký Újezd in 2014 in global. A you can read from the different articles and analysis, the Czech Republic belongs to the best separating countries of the European Union. After studying the table and the graph, the result is not such positive. Three thirds of the total waste is still residual waste that end up on the landfill. According to the new law it will not be possible to place the residual waste in landfills.

Tab. 6.: Types of waste in 2014 (in tons)

YEAR	paper	glass	plastics	tyres	liquid chemicals	batteries	non-biodegradable waste	bulky waste	residual waste
2014	18,87	14,06	17,46	0,42	0,27	0,07	4,94	35,76	256,03

source: own, on the basis of the Reports



ECONOMIC ASPECTS OF WASTE SEPARATION IN VELKÝ ÚJEZD

As mentioned above, the town cooperates with the EKO-KOM company in waste separation. According to the EKO-KOM website *„The company and the town sign a contract to meet the duty of reverse take-offs and using the waste from packaging materials ….”*[7]

The table No 7 compares the costs spent on different types of waste. The numbers regarding separated, bulky waste and waste from cemetery in 2014 come from the annual report, the dates form 2004 were not available already.

Tab. 7.: Comparison of costs in 2014 and 2004

COSTS / YEAR	2014	2004
paper, plastics, glass	211 244 Kč	N/A
bulky waste + cemetery	107 299 Kč	
hazardous waste	10 142 Kč	10 582 Kč
residual waste	401 448 Kč	259 418 Kč
total	*730 133 Kč*	*270 000 Kč*

source: own, on the basis of the Reports

Important numbers are based on the comparison of the table No 7 and No 8. Regarding waste separation, the town spent 211 244 CZK and got 146 380 CZK back from the EKO-KOM company, which is nearly 70 % of the expenses. Here comes the question – is it better (for the municipality) to have more waste and thus to get more money?

Tab. 8.: Comparison of income in 2014 and 2004

INCOME FROM / YEAR	2014	2004
EKO-KOM	146 380 Kč	31 585 Kč
residents	527 786 Kč	267 000 Kč
total	*674 166 Kč*	*298 585 Kč*

source: own, on the basis of the Reports

Costs on hazardous and residual waste collection and processing are taken into account in specifying the fee on waste management that is paid by all residents. The amounts of the fee compared between the years 2004 and 2014 and between Velký Újezd and Přerov show the table No 9.

7 *Smlouva s obcí*. Retrived from: http://www.ekokom.cz/cz/obce-a-mesta/zapojene-obce/smlouva, [cit. 5. 4. 2015]

Tab. 9.: The fee in 2014 and 2004, in Velký Újezd and Přerov

RESIDENTS PAY IN / YEAR	2014	2004
Velký Újezd	**400 Kč**	**250 Kč**
	150	110
	250	140
Přerov	**650 Kč**	**400 Kč**
	186	225
	464	175

source: own, on the basis of the Reports

PAPER IN POST BOXES

One more analysis was done to make the picture about waste in household complete. The magazines from supermarkets and different offers that were delivered into the post box in the time of one week were put on the scale. Half kilo of paper (see Fig. 4.) was delivered during one week to one household in one town. That is 26 kg of paper a year in one household in one town. Luckily paper does not belong among the questionable materials. But still it is demanding for the environment and exhaustible resources.

Fig. 4.: The quantity (0,5 kg) of magazines per one week

source: own

CONCLUSION

People were used to glass in the Czech Republic till 1989. After 1989 we buy products in plastics and probably can´t imagine to carry e.g. mineral water in glass any more. That is development. We need innovations for our life. But sometimes the innovations mean the step back. It is 100 % true for the environment in this case.

Everyone of us can help to protect the environment. If the producers, the companies benefiting from packaging materials, the future waste, start to use the sources reasonably, then the change is possible and may be visible.

The waste in our households can be controlled by ourselves. Each of us can buy products that generate minimum waste and then deal with the necessary waste reasonably.

Regarding Velký Újezd, it may be interesting to monitor the amounts of waste after the containers for metal and bio waste were introduced.

The residual waste is a big question nowadays. On one hand we pay for landfills, on the other hand e.g. cement mills pay for the waste to burn it as alternative fuels.

We have lots opportunities on the level of high politics or in particular households to deal with the waste rationally, let´s do it.

LITERATURE

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[2] Zákon č. 185/2001 Sb. o odpadech a o změně některých dalších zákonů, § 4, § 9a (translation)

[3] *Reduce Waste, Recycle More!* [on-line]. Sustainability and environmental management, [cit. 5. 4. 2015]. Retrived from: http://www.garrison.hawaii.army.mil/sustainability/ SolidWaste .aspx

[4] *Přehled dosahovaných výsledků* [on-line]. EKO-KOM, [cit. 5. 4. 2015]. Retrived from: http://www.ekokom.cz/cz/ostatni /vysledky-systemu/vyrocni-shrnuti (translation)

[5] *O keramickou popelnici 2014* [on-line]. Jak se točí odpady, [cit. 5. 4. 2015]. Retrived from: http://www.jaksetociodpady.cz/odpady/index.php?page=2-o-keramickou-popelnici-2014 (translation)

[6] *Smlouva s obcí* [on-line]. EKO-KOM, [cit. 5. 4. 2015]. Retrived from: http://www.ekokom.cz/cz/obce-a-mesta/zapojene-obce/smlouva (translation)

[7] Regulations, reports and bookkeeping of Velký Újezd

Reviewers:

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FLOW CONTROL OF THE CAR TOWN

ŘÍZENÍ AUTOMOBILOVÉHO TOKU MĚSTEM

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Abstract

In this contribution a new method of traffic light control according to update traffic density will be described. This method will be devised in the simulation program Witness. The proposed method should be applied to the junctions where the situations of high and low traffic density change during the day, and the traffic lights are necessary at high density and almost useless at the other intervals.

Abstrakt

V příspěvku bude popsána nová metoda řízení světelných signalizací podle aktuální intenzity dopravy. Tato metoda bude navržena v simulačním programu Witness. Navržená metoda by měla být aplikována na křižovatkách, kde se v průběhu dne střídají situace s velkou a malou hustotou provozu a kde je světelná signalizace nutná při velké hustotě provozu, ale téměř zbytečná v ostatních intervalech.

Keywords

Traffic flow, optimization, program Witness, traffic lights.

Klíčová slova

Automobilový tok, optimalizace, program Witness, světelná signalizace.

INTRODUCTION

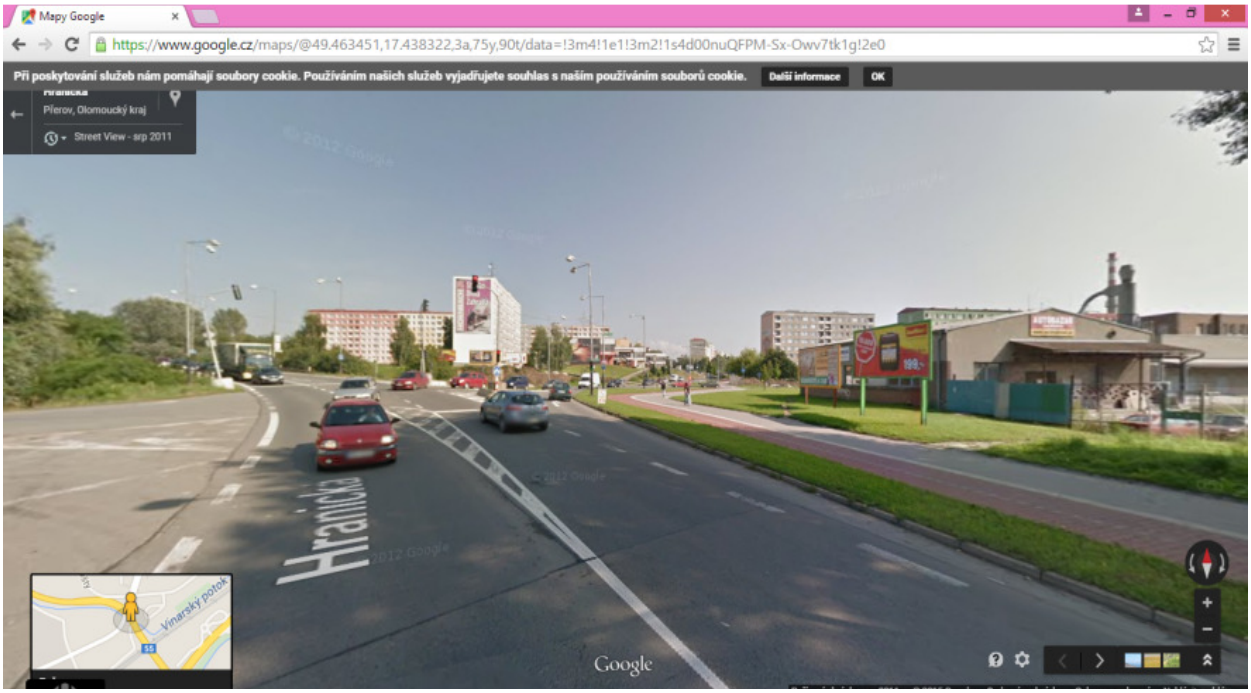
The essay deals with the issues of traffic flow control in the cities because it is a hotly discussed topic nowadays. In view of the fact that the number of cars is growing dynamically every year, it is necessary to focus on the control of road transport in the cities.

TRAFFIC TASK – TIME DETECTION OF SWITCHING OFF THE TRAFFIC LIGHTS

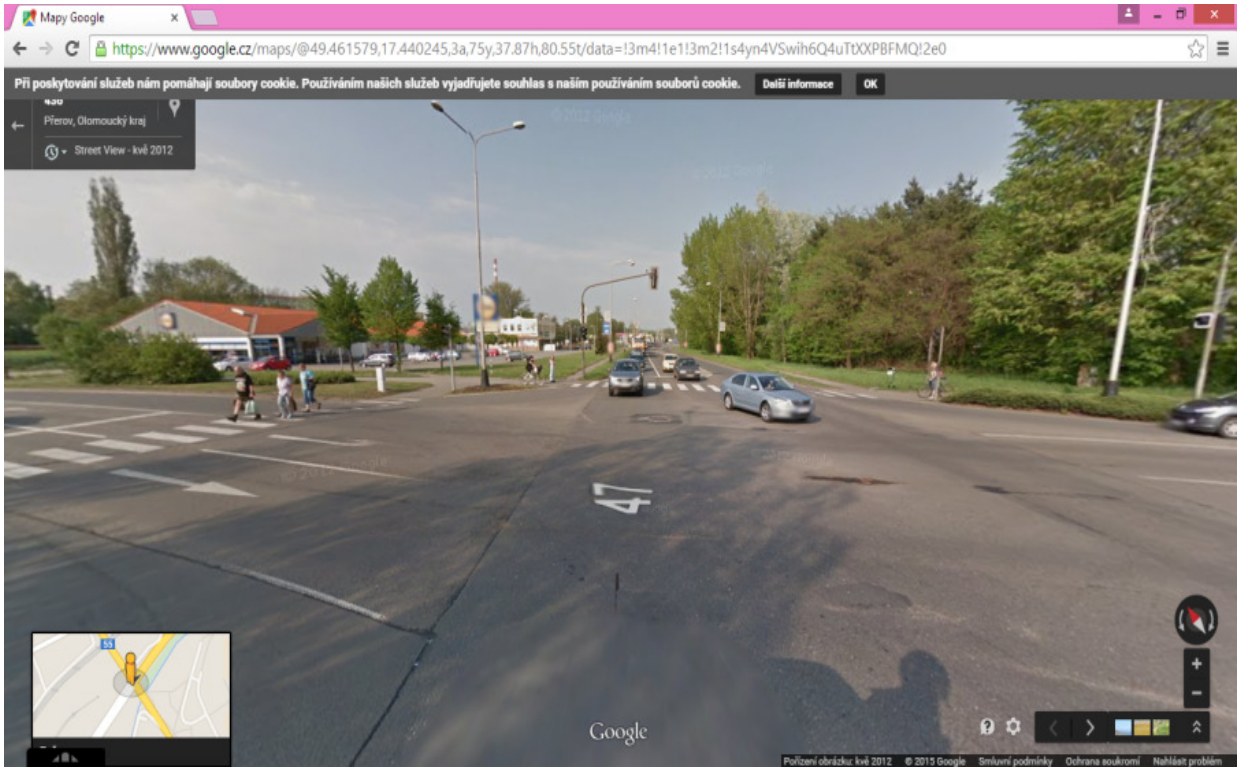
The traffic task takes place at two junctions with traffic lights. The aim of this traffic task is to find the moment when switching off the traffic lights is efficient, so the traffic flow in the cities will be improved.

It was discovered on the basis of the analysis of the traffic capacity through the town Přerov that the junction in Předmostí is a narrow place (see picture no.1). For this reason the process of optimization of traffic flow will be suggested with the use of switching on and off the traffic lights according to the traffic intensity. The aim is to improve the traffic capacity and flow of the road transport in the cities. [5]

In view of the fact that the junction in Předmostí is closely connected with the junction on Lipnická street (see picture no.2), it is also included into the simulation programme.



Picture no. 1: Junction in Přerov II - Předmostí [3]



Picture no. 2: Junction on Lipnická street [4]

EXPLANATION OF THE ISSUES OF THE TRAFFIC TASK

The heart of the matter is to find the limit of traffic capacity that is not efficient anymore, when using the traffic lights at the junctions.

The driving time through the junctions is set by the ratio of green color in particular junctions and the cycle time. The driving time is lengthened by each enlargement of a tailback. The green light at the traffic lights blocks the transverse direction. If the traffic lights are set in the right way, the cycle time is reducing during the decreasing traffic capacity till the complete switching off the lights.

When switching off the traffic lights, the traffic is already not heavy, the driving time through the junction to the main road is almost zero, but we have to take into consideration the delay of cars from a side street. Switching of the traffic lights during the low traffic is advantageous because it goes to more fluent traffic, the cars do not have to wait in tailback and can move on as scheduled.

THE METHOD OF OPTIMIZATION – THE SIMULATION PROGRAMME WITNESS

The simulation programme Witness serves for simulation and optimization of production, operating and logistic systems. The simulation in the programme Witness is helpful because we can create a model of the system that has not existed yet. The next advantage of the programme Witness is that the simulation time is chosen as necessary. In the programme Witness the time can be set to run faster than in reality, which enables us to get valuable results in order to optimize a given task.

The simulation programme Witness will be used for optimization of traffic flow through the city. Namely the simulation of traffic light junctions that were determined as narrow places on the basis of analysis of traffic capacity in the programme ArcGIS Network Analyst will be carried out.

It will be discovered with the use of webprogramme Witness when it is efficient to switch off the traffic lights in order to fix fluent traffic flow in medium-sized cities.

THE METHOD OF SOLUTION OF THE TRAFFIC TASK WITH THE USE OF THE SIMULATION SOFTWARE WITNESS

In this part the method of optimization of the traffic flow, which will be solved with the use of the programme Witness, will be described. Passing through the junction $\mathbf{t_P}$ "so called driving time of a driver" is an optimization criterion. The main aim of this traffic task is to find the transport density and the time when switching off the traffic lights is effective. At the same time the partial aim is to find the limit during increase of the traffic density when the traffic lights should be switched on again.

As was mentioned above, first the analysis of the traffic capacity was made. On the basis of this analysis the narrow places and traffic lights were found out and will be the subjects of optimization. The traffic model of two subsequent junctions with traffic lights will be simulated in Witness. The method of optimization of the traffic flow will be indicated.

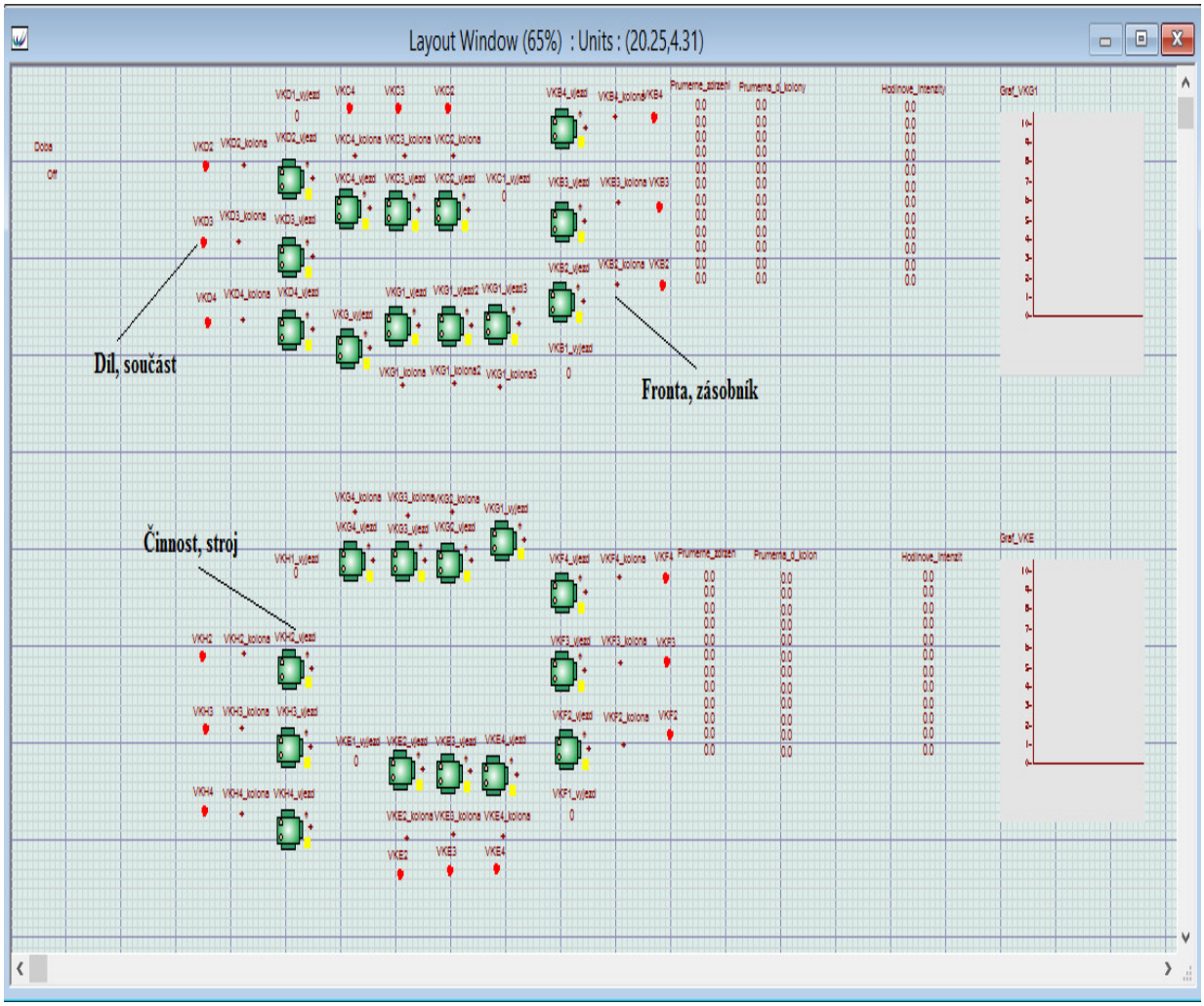
SETTING OF SIMULATION ELEMENTS

Simulation elements are divided into following basic groups – discrete, logic and graphic.

The first simulation element which is used in the simulation programme Witness is entity – part which serves for the setting of intensity of particular traffic streams and exits (setting of a course).

The following simulation element is a queue – buffer which also falls into the discrete qroup. The next simulation element is queue – buffer, which also belongs to the discrete group. Functions for the calculation of an average delay and average length of a tailback are set for particular queues.

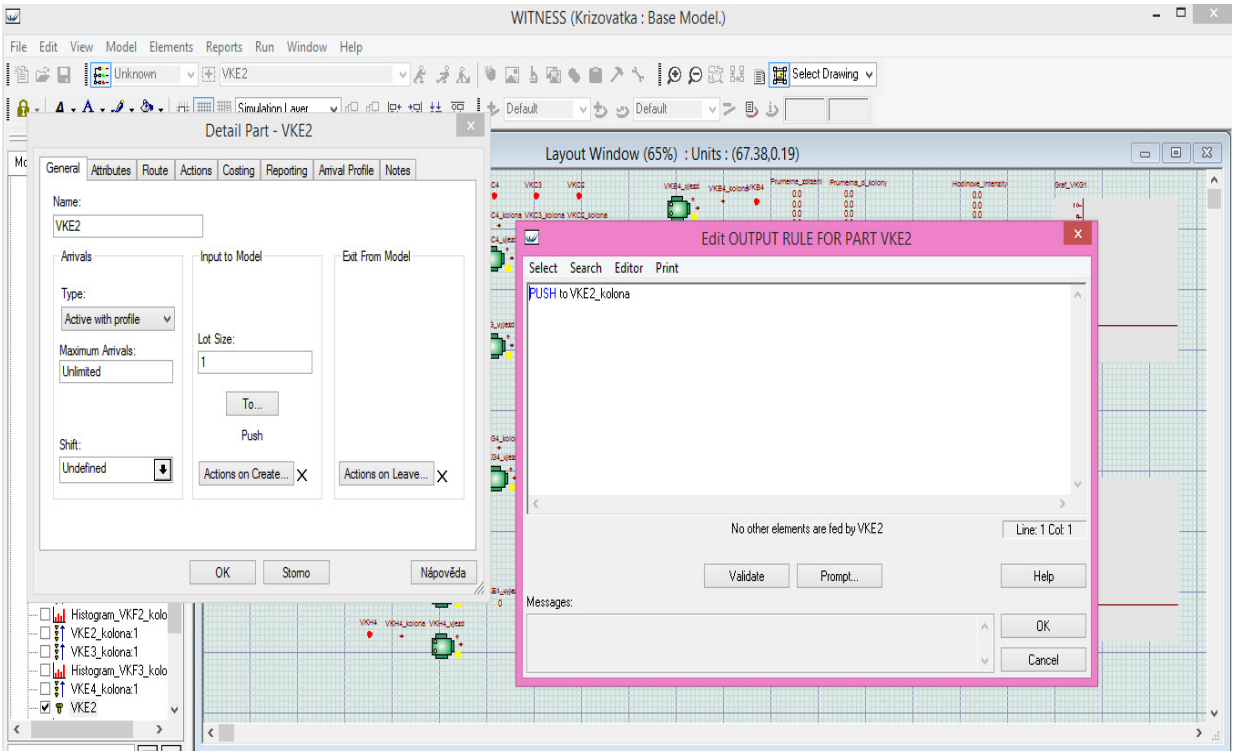
The next element is activity - machine which is the most complex element of the simulation programme. [2]



Picture no. 3: Description of simulation elements in Witness

SETTING OF SIMULATION ELEMENT – PART

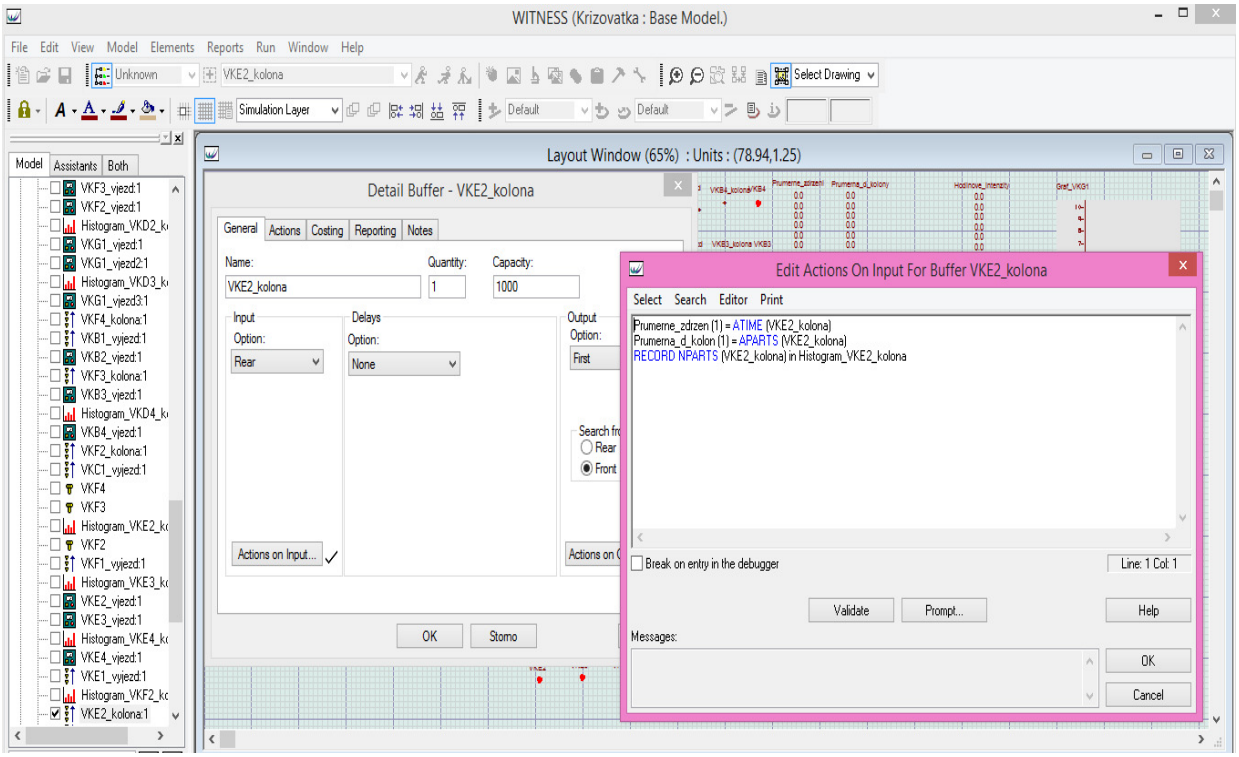
The intensity for each phase of the traffic stream is set with this element. Concurrently the input where particular cars are to continue is to be set in this element (see the picture no.4). In this case they are to be headed for a tailback, from which the data are computed.



Picture no. 4: Setting of Output rule for Part

SETTING OF SIMULATION ELEMENT – BUFFER

All the cars go through the simulation element buffer. The data are computed from this element (see picture no.5).



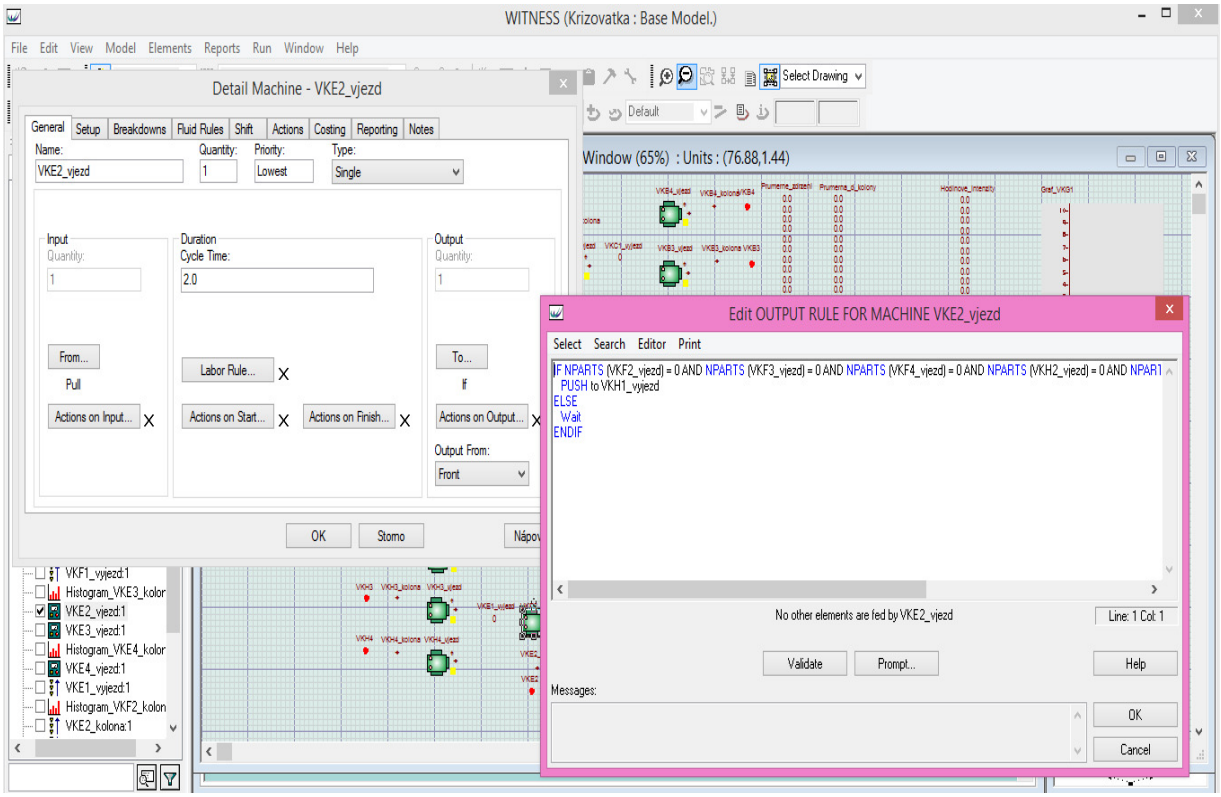
Picture no. 5: Setting of Action on Input for Buffer

There are used these functions:

- *Delayed on average (1) = ATIME (VKE2_tailback)*
- *Average_d_tailback (1) = APARTS (VKE2_tailback)*
- *RECORD NPARTS (VKE2_tailback) in Histogram_VKE2_tailback*

SETTING OF SIMULATION ELEMENT – MACHINE

There is an input in the simulation element machine in which it is set that the cars from tailback are to enter in this element*„PULL from VKE2 out of VKE2_tailback”*.



Picture no. 6: Setting of Output rule for Machine

This case immediately concerns the junction without the traffic lights (see the picture no.6). At the same time an output is set in the detail of the element. There are conditions that the car has to keep in order to go through the junction and traffic flow:

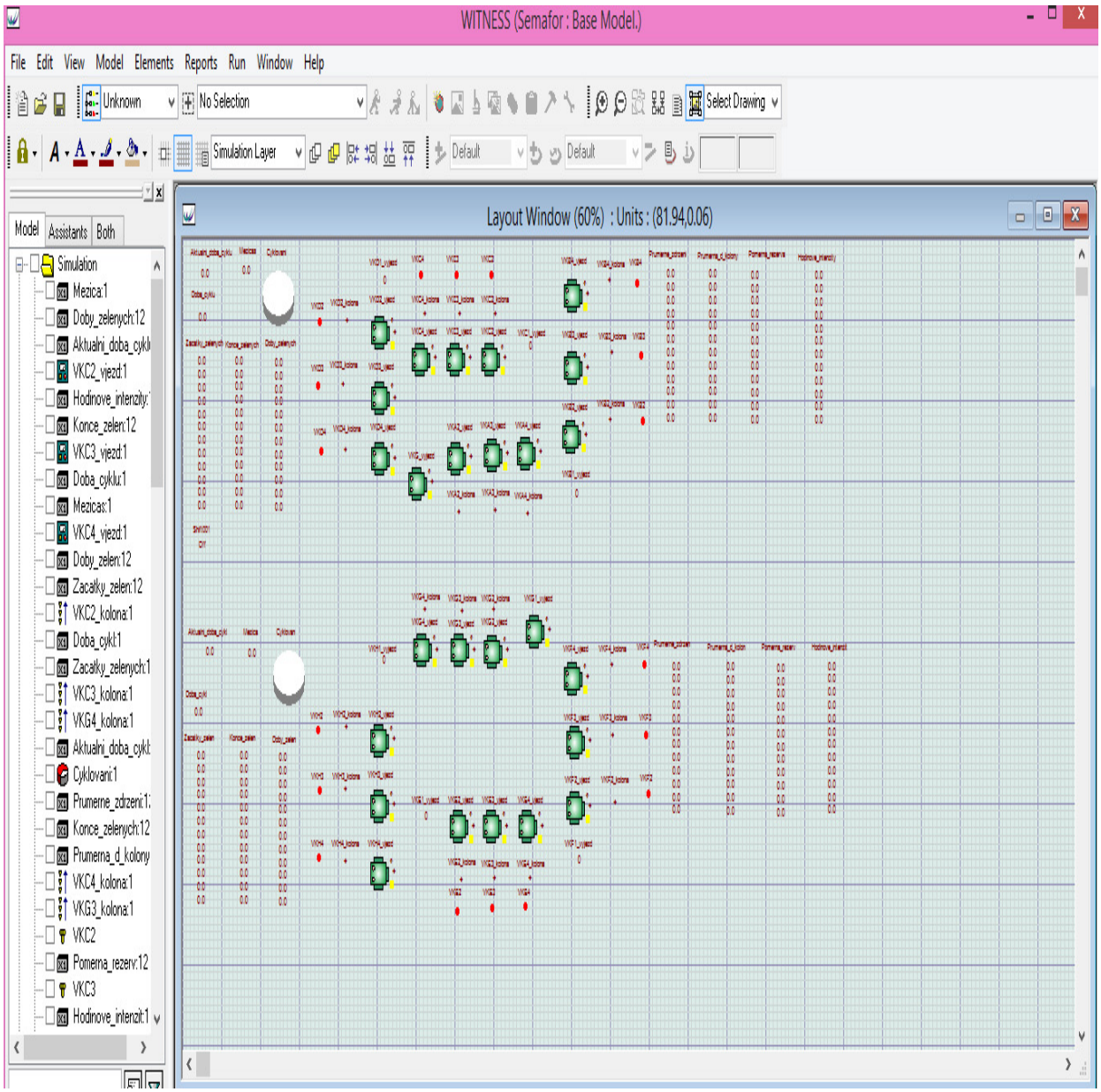
IF NPARTS (VKF2_entry) = 0 AND NPARTS (VKF3_entry) = 0 AND NPARTS (VKF4_entry) = 0 AND NPARTS (VKH2_entry) = 0 AND NPARTS (VKH3_entry) = 0 AND NPARTS (VKH4_entry) = 0 AND NPARTS (VKG3_entry) = 0

PUSH to VKH1_exit

ELSE

Wait

ENDIF



Picture no. 7: Junctions with traffic lights

As for the case of the junction with traffic lights (see the picture no.7), there is set a cycle of traffic lights at the entry to each traffic stream for the cars to go in an intersection when the lights are green, and concurrently the direction of the course is determined:

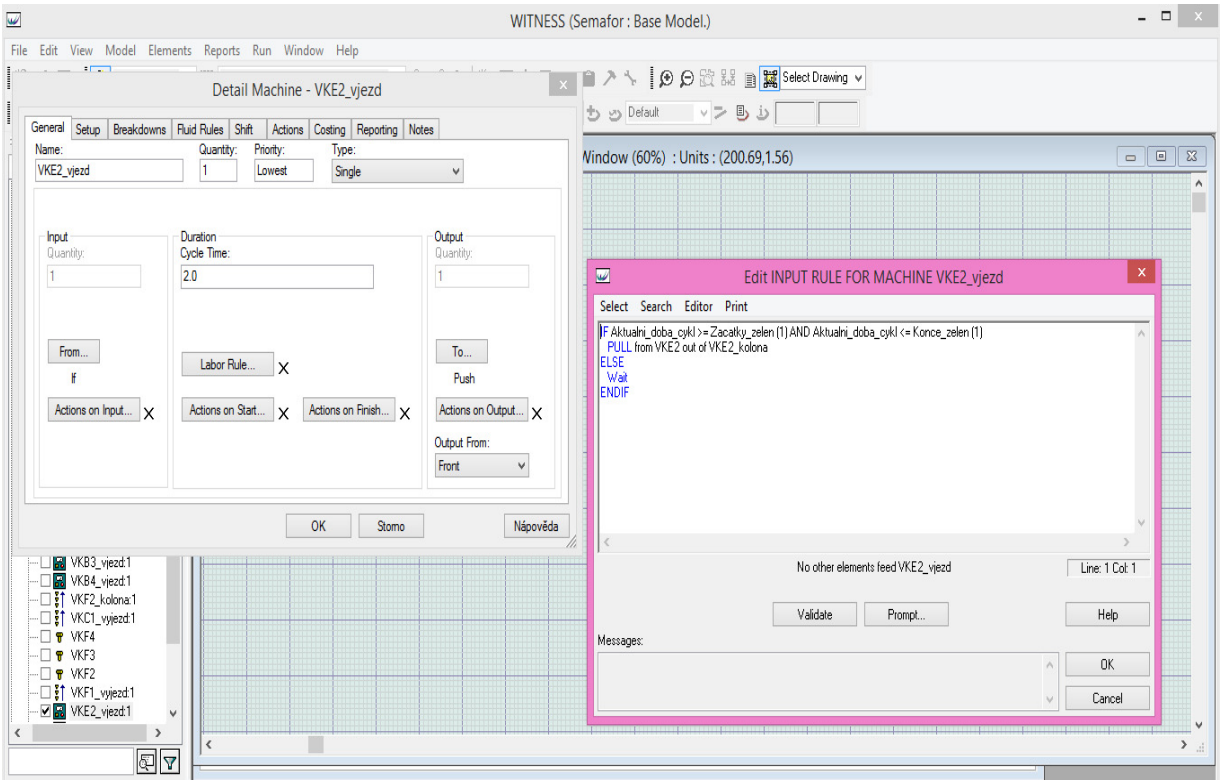
IF Current_cycle_time>=Beginnings_green(1) AND Current_cycle_time<=End_of_green(1)

PULL from VKE2 out of VKE2_tailback

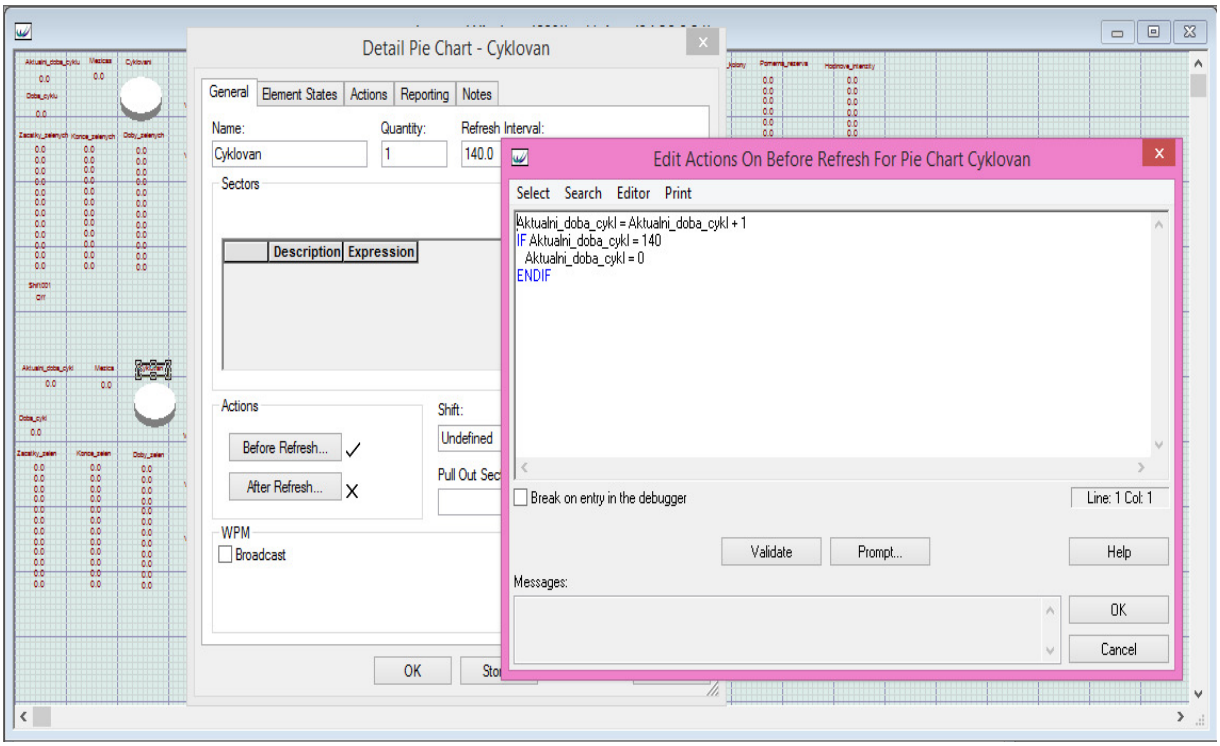
ELSE

Wait

ENDIF

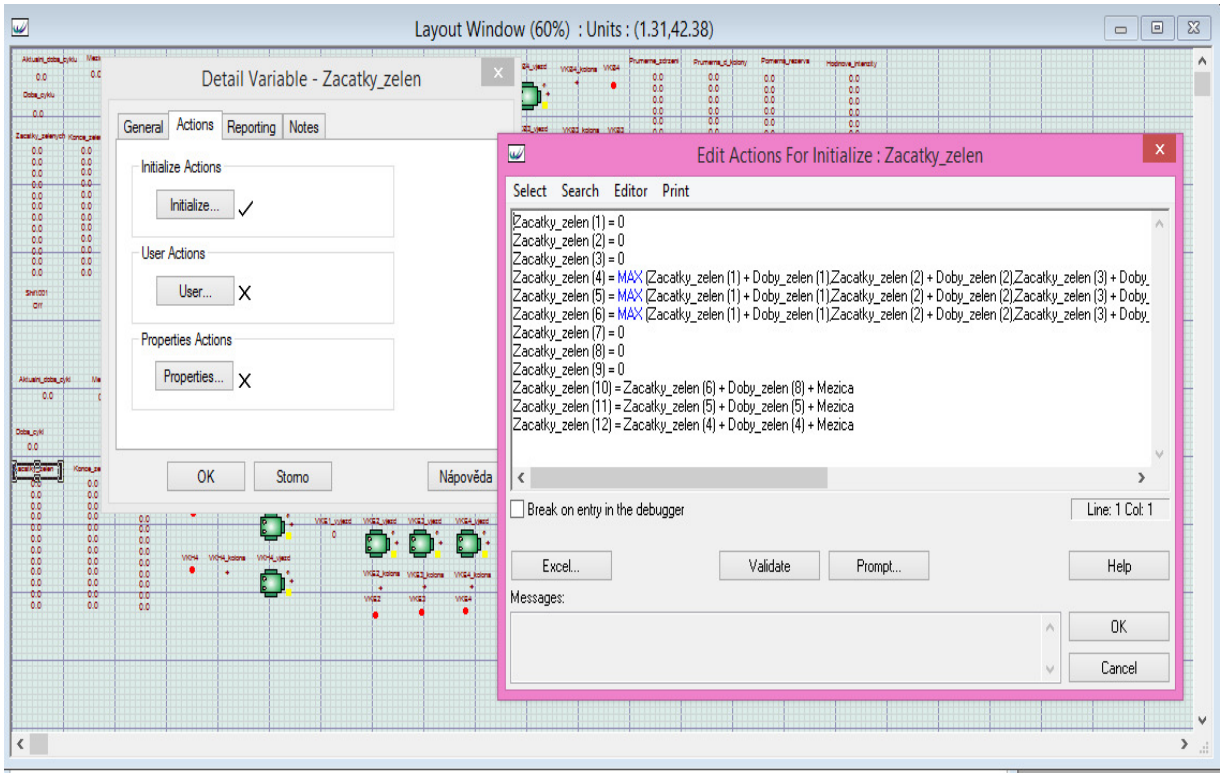


Picture no. 8: Setting of Input rule for machine



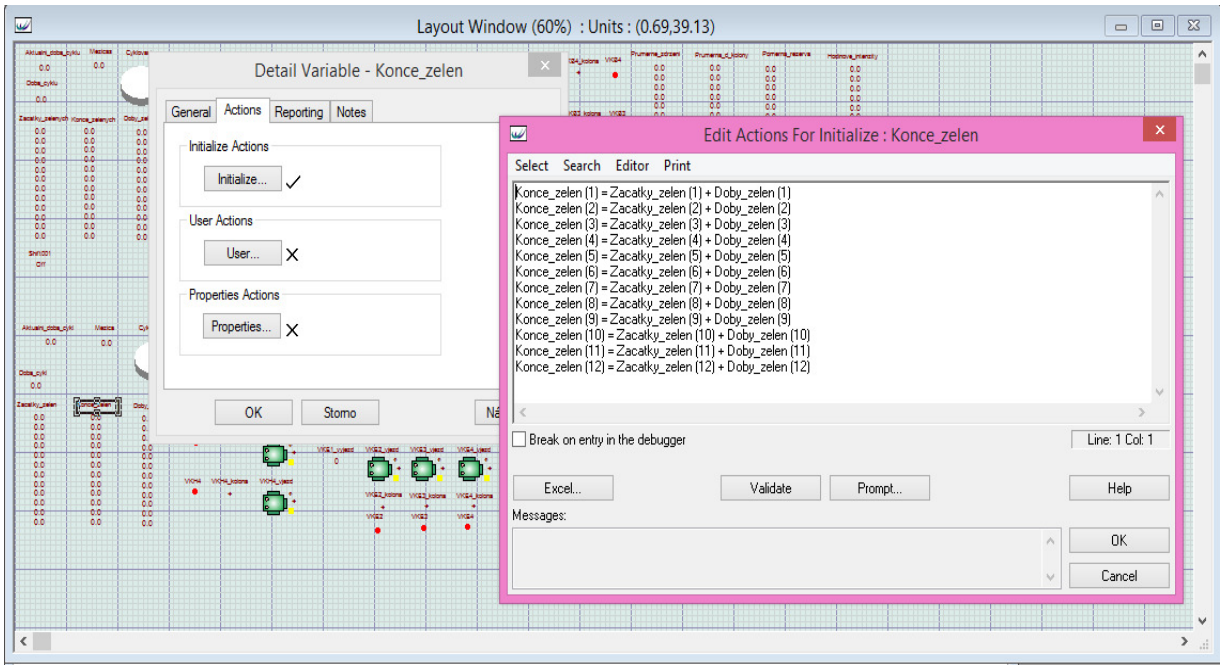
Picture no. 9: Setting – Cycle

It is necessary to have the setting of cycling for simulation of junctions when the traffic lights are on (see the picture no.9).



Picture no.10: Setting – Beginning of green

When the traffic lights are on, the beginning of the green light is to be set according to phases of the traffic stream (see the picture no. 10). Simultaneously the endings of green lights have to be set in the simulation programme (see the picture no.11). Lastly the lengths of the green lights have to be indicated in the simulation programme. [1]



Picture no.11: Setting – Endings of green

CONCLUSION

The aim of this paper was to describe the method of traffic light control according to the update density. The method of optimization of traffic flow control is introduced in the simulation programme Witness.

The proposed method should have been applied with the junctions where the situations of high and low density change during the day and the traffic lights are necessary when the density is high and almost useless at the other intervals. When the changes in control of junctions are necessary or not, and also depending on the situation of subsequent junctions, this is the main aim of the paper on the proposed simulation model. The results of optimization should increase the transport capacity and cut the fuel consumption, so drivers could continue at steady pace and they do not have to stop and start up their cars at the junctions in a purposeless way.

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IMPORTANCE AND USAGE OF MICRO LOGISTICS CENTRE IN PROCESS SUPPLY CHAIN MANAGEMENT FOR ORGANIC FOOD

VÝZNAM A VYUŽITÍ MINILOGISTICKÉHO CENTRA V PROCESU SUPPLY CHAIN MANAGEMENT BIO POTRAVIN

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Abstract

The description of importance and usage of the micro logistics centre which is built for given location. The Micro logistics centre as a sustainable part in the supply chain management. In this article is described reason for building this kind of warehouse. There are common processes which are situated inside this micro logistics centre. The Micro logistics centre is supplied with the goods from the local or the nearest farmers to provide the most complex food solution. We are going to offer other value added services as a manufacturing for a meat, storing the wine etc. The main idea is the supply chain management of the quality local organic food for efficient price to its customer. We need to focus on the most modern available method and technologies.

Abstrakt

Popis významu a využití minilogistických center, které jsou budování pro konkrétní lokalitu. Minilogistická centra jako soběstačný prvek v procesu supply chain managementu. V příspěvku budou popsány procesy, které se uskutečňují v takovémto minilogistickém centru, které je závislé na dodávce od farmáře a na požadavcích zákazníka. Budou navrženy další možnosti zpracování, které mohou být umístěny v tomto centru např. zrárna masa. Základní myšlenka je dodání biopotravin zákazníkovi v nejlepší BIO kvalitě za cenu, kterou je ochoten zaplatit. K tomu musí být využity všechny dostupné metody a technologie.

Key words

Sustainability, distribution, organic food, supply chain management, warehouse

Klíčová slova

Udržitelný rozvoj, distribuce, BIO potraviny, dodavatelský řetězec, sklad

INTRODUCTION

Society creates new ideas how to protect environment. All of the developed countries have already known environmentally friendly way. There are new challenges how to do it. This article is written with an idea to uncover and go deeper to the core of sustainability. Here is no doubt about the interest in this area. A lot of people spend them time, money and experiences to work on sustainable culture. They are focusing on new technologies to provide healthy lifestyle with as little effect on environment as possible. At the end of the day it is up to us to decide where we are going to go.

Ways how to protect environment in our lifestyle

- Local food (fair trade markets, fair trade label)
- Organic food

- Less personal traveling for long distances
- Reduce the waste (recycling)
- Etc.

Dangers of our lifestyle:

- Toxins in environment
- Toxins in food

We can choose one of many ways how to decrease our impact on our planet and on our local environment. At the moment we are looking for the complex solution which is easier to use in the reality. Our life attitude could be harmless. For example: One week of our life includes 5 days at work and 2 days at home with our family. For every day we need to eat, travel and use different equipment and devices. In all these processes we consume and create the negative impact on the earth. An important fact is that in the food packaging has a lot of toxic solution as phthalates. That is why organic food is essential. Our food comes from far distances. How can we reduce our well-known food miles apart from other things? Simply to eat the food which comes from the nearest destination. There are a lot of farmers around us who grow the quality food. Nowadays, there is an increase in farmers´ fair trade markets.

Organics certification gives us guarantee for less harmful effect on water sources, chemist contentment in soil or in the product itself, etc. The Czech customer can recognise the products with logo under. There is also European logo.

Fig. 1: Organic food label for the Czech Republic, label for the European Union
Source: http://biospotrebitel.cz/chci-znat-bio/jak-poznam-bio/znaceni-biopotravin

"Consumers have become more aware of the environmental impact of their purchases, along with non-governmental organizations (NGOs), are setting the agenda for transitions to organically grown foods, anti-sweatshop labour codes, and locally produced goods that support independent and small businesses. Because supply chains may account for over 75% of a company's carbon footprint, many organizations are exploring ways to reduce this." [1]

MEASUREMENTS USED FOR SUSTAINABILITY

How can we measure the negative affect of the food which we eat? There are two terms: food miles and the carbon footprint. Food miles refer to the total distance food has travelled before it is sold. The carbon footprint is the amount of carbon produced for the distance food has travelled before it is sold and produced. The less carbon dioxide emissions is produced the less negative impact on environment is created.

"A Swedish study looked at the ingredients of a typical Swedish breakfast- apple, bread, butter, cheese, coffee, cream, orange juice, and sugar and determined the food travelled a distance equivalent to the circumference of the earth. That's 24,901 miles." [2]

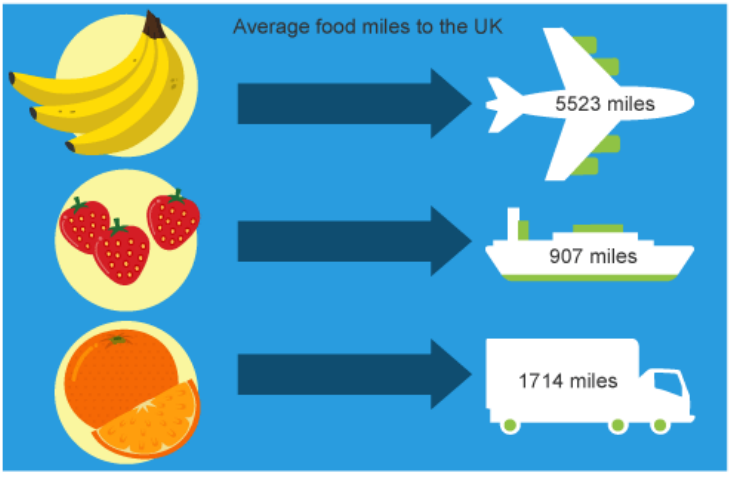

Fig. 2: Average food miles to the UK
Source:http://www.bbc.co.uk/bitesize/ks3/geography/human_processes/changing_shopping_patterns/revision/5/

RESEARCH

This article is the part of the dissertation work which is divided into the three sections of the research:

A. Searching for methods and the structure used in the sustainable food supply

B. Analysing the best option for the sustainable food supply

C. Suggest the best available option for the sustainable food supply including the newest technology

A. On the market is enough possibilities for environmentally thinking people. There is also legislation for the protection of the idea. There is a lot of companies offering the products and services in this sector.

Distribution to its customer

The conducted survey was made by the Czech ministry of agriculture in year 2014. It was mentioned that 60% of customers buy their organic products on the marketplace and on the farmers' festival. Other places for shopping are supermarkets, specialized shops, farms, the internet, through "bin consortiums" and food shops.

The ideology of organics products prefer not to us supermarkets but go for less commercial method with the visible non harmful impact on the local environment. There should be positive economic, social and environmental influence on local people. This research focuses on one of 14th regions in the Czech Republic. "*Olomouc region rich in traditions and history the evidence of which are hundreds significant architectural monuments. It is also a region full of colourful nature with cultural, and sports and recreational possibilities all making it a popular destination for visitors.*

The local economy is primarily driven by traditional agriculture, the manufacturing industry and services all of which provide a range of possibilities for foreign investors who have at their disposal prepared industrial zones as well as favourable state incentives.“ [3]

On 5th April 2015 was registered 4462 companies dealing with organic products. This includes:

- Organic agriculturists
- Organic manufacturers
- Companies importing the organic goods
- Companies exporting the organic goods
- Organic producers for fish, honey, mushrooms etc.

For Olomouc region is registered 275 companies dealing with organic products. There is 249 subjects dealing with the organic agriculture. In the whole Czech Republic is 3937 organic agriculture farmers. In the whole Czech Republic is produced organic products on 473076.10 ha. That is more than 10 % of cultivated soil. In Olomouc region is 38700.28 ha used for producing organic products. From these statistics information we can see that to deal with the sustainable food supply of organic goods is the important part of the Czech economy. There is also general increase it the Czech Republic and the European Union in organic food demand.

B. The supply chain management to its customers could be done by farmers, marketplaces, farmer festival, specialized shops, internet, “bin consortiums” and food shops.

We are thinking about the new method which includes few of them. We need to achieve the most efficient way to transport the organic food because the barrier to most customer is money. We also don’t want to put all the pressure on the farmer- farm produces directly on the farm itself "farm-direct sale". We want farmer to produce not to sell. We definitely think that there is enough space to use the Micro logistics centre.

<u>The Micro logistics centre</u>

Preferably, we call the place which is the part of supply chain management the Micro logistics centre, but for better understanding we also use the term the Micro warehouse. The Micro logistics centre is used name for the place which is part of the supply chain for the farmers’ goods. There are also the value added services as pacing, kitting, labelling etc. There is also place for other processes as manufacturing of meat, storing the wine etc. As a short term we can call it the Micro centre.

Processes in the Micro warehouse

- First, the goods are checked in the receiving area.
- The goods are unpacked to make format suitable for warehousing or to be selected for customer order. Most of inventory is the part of Cross-docking system. “*Cross-docking is basically the action of unloading materials from an incoming trailer or rail car and immediately loading these materials in outbound trailers or rail cars thus eliminating the need for warehousing (storage). In reality pure cross-docking is less common; most "cross-docking" operations require large areas where inbound materials are sorted, consolidated, and stored until the outbound shipment is complete and ready to ship.”* [4]
- After that, the part of the inventory is placed in the storage.

- The goods will be packed in the units required by the customer.
- The goods has been selected to complete customer orders in the order picking area.
- The orders have been sorted down.
- The goods may be wrapped or labelled according to the customer´s requirements.
- Other value added services may be offered.
- The goods are consolidated and made ready for dispatch.
- Finally, the goods were loaded onto vehicles in the dispatch area.

WAREHOUSE MANAGEMENT SYSTEM

Our customers expect the high quality, local food, good price, environmentally friendly impact, wide range of products, as little packaging as possible and more. There are the possible way how to meet them needs.

Goods

Products store in the micro warehouse should preferable be domestically-produced food. The idea is to support independent and the small business in the given region. However the farmers produce the local food, we also use foreign suppliers.

Value added services

There are also needs for more services to be provided. At the moment in the supply chain management of the Czech market isn´t any the place for process of curing the meat. As we know for the delicious taste of it. For example, the beef steak is necessary leave the meat at least 10 days. Customers are requesting quality meat but we need to find the place to leave the meat for this period. Here is one possibility to leave the meat at the farmer´s side but we do not want to give this responsibility on him. That is why the micro warehouse could wider its services. Another idea is to store wine or fruit and vegetable for minimum period of time before is dispatched.

Labelling

From 1st April 2015 there is the regulation for all the European Union to give customers information about the breading and the killing place of pork, chickens, goat and ship meat. The place of origin for beef, olive oil, fruit and vegetable is already given.

We would like to focus in our research on RFID technology suitable for mentioned information and provide customers more information. On RFID tag could be unloaded endless information. For example:

- The place of origin
- Information about farm
- Information about farmers other products
- The recommendation of customer
- 3D visualisation
- The list of recipes etc.

Dispatch

It depends on amount of shipping goods. There is possible to use one or two vehicles for all the shipments. We can expect to deliver every day.

Customers

Individual customers, restaurants, company canteens, school canteens etc.

Procurement and delivery

Freshness, taste and good quality are characteristics for the organic food. To achieve all these qualities it is necessary to use the local farmer or the nearest as possible. There are going to be also suppliers for the close countries if we want to offer the wide range of products. For example: the rice from Pakistan, cuscus from Italy, the buckwheat from China. We have already known that we are not going to depend only on the Czech food production but we can be still sustainable in the delivering the goods to its customer. There is one possibility how to do it. The raw food as cereals and grains are supplied in the big amount and resold in the smaller quantities as a part of the customer´s order. There is new method for this idea implementing at the moment in the Czech Republic. Its name is "Without packaging – Bez obalu". They are going through the trial. They are implementing the Czech legislation about hygienic achievements. If it was successful, it would be part of the micro warehouse.

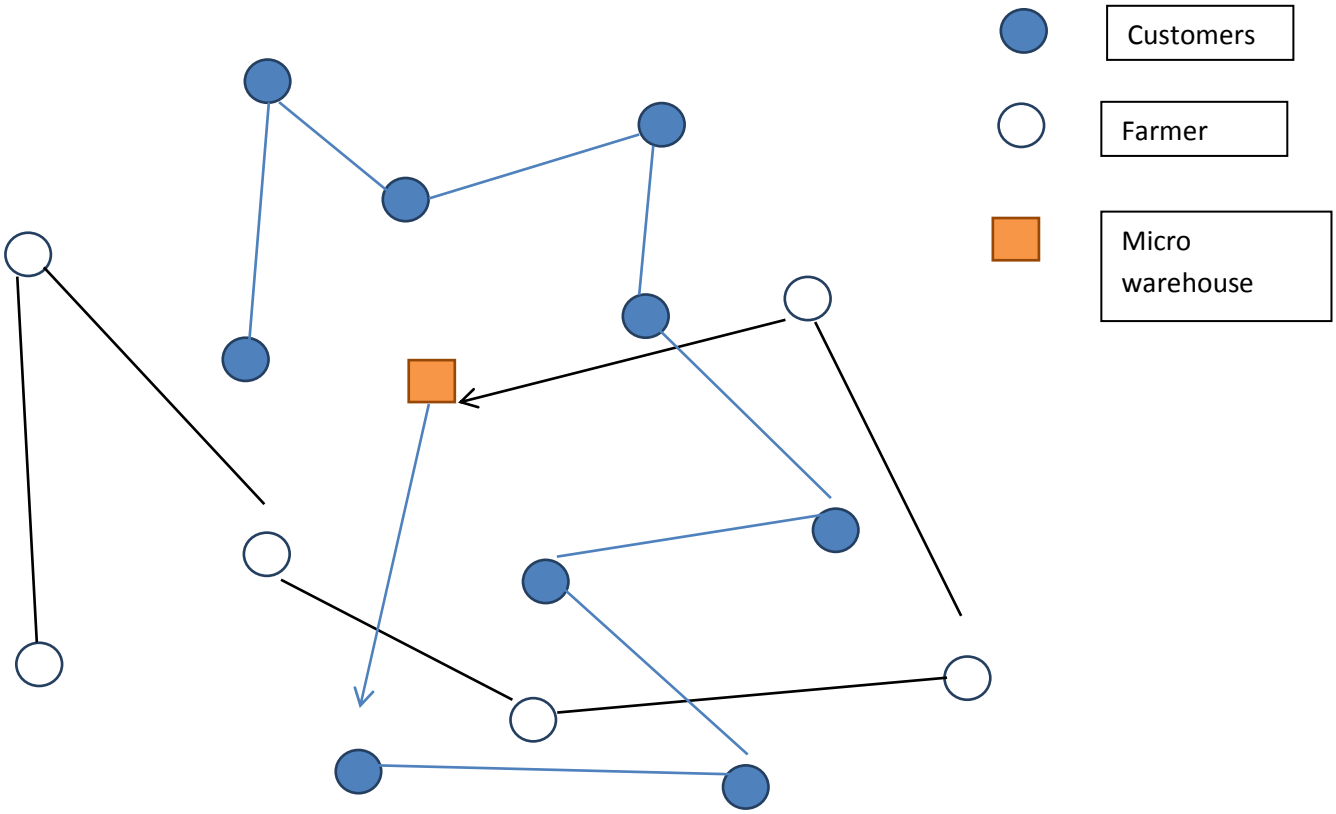

Fig. 3: Procurement and delivery of micro warehouse
Source: Author

CONCLUSION

What could be more important in our life than the health, clean environment a quality food? That is why the science is trying to deal with these problem: "How to minimize negative impact during the transport and the manufacturing of food." That is why people want to spend the money for the organic food. The public and private sector can clearly understand all the necessary needs to push these ideas little bit forward. That is why we work on this global issues.

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TRANSPORT AND ENVIRONMENT – CONTAINER RAIL SPEED TRANSPORT

DOPRAVA A ŽIVOTNÍ PROSTŘEDÍ – RYCHLOSTNÍ ŽELEZNIČNÍ KONTEJNEROVÁ DOPRAVA

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Abstract

Each transport system is undergoing evolution over time. Today's existing rail freight shipments for transport capacity is insufficient, because it uses the same routes as passenger traffic. The purpose of this article is to outline ways to effectively build a new freight transport system for use today known technologies, means of transport and management system.

Abstrakt

Každý dopravní systém prochází časem vývojem. Dnes, stávající železniční nákladní doprava má nedostatečnou přepravní kapacitu, protože používá stejné trasy jako osobní doprava. Cílem tohoto článku je nastínit způsoby, jak efektivně budovat nový systém nákladní dopravy pro použití dnes známých technologií, dopravních prostředků a systému řízení.

Keywords

speed transport, container, environment

Klíčová slova

rychlostní doprava, kontejner, životní prostředí

INTRODUCTION

Since the beginning of its inception man addresses the need to move themselves and their property. First means the animals and various carriers. Was a great invention of the wheel, which enabled the construction of the first primitive means of transport. Further development of human society and the need to seek new lands for colonization already lays the foundation for the development of transport. Transport and enables the development of trade and travel between settlements. In the 19th century, the invention of the steam engine caused not only the industrial revolution, but also the emergence of a rail, road and water transport using the machine. The steam engine was able to increase the amount of transported people and material for part-time at virtually unlimited distances. The last major factor affecting traffic in recent years is globalization. This phenomenon can increase store traffic and accelerate provide work for people, but it also means congestion of existing transport infrastructures and major environmental damage.

The world´s most used these four modes:

- air transport
- road transport
- shipping
- rail transport

Air transport is used over long distances and in less populated areas where otherwise miss another kind of transport infrastructure. The positive air traffic is distributed worldwide for its speed, relative cheapness and as a "safe" mode of transport people and cargo. The downside of air transport are high demands on manning, construction of major airports and high fuel consumption. Fuel consumption directly affects the environment in many toxic combustion gases, which are emitted in flight in the clouds and act on the ozone layer of the atmosphere.

Road transport is the most common type of ground transportation worldwide. It can transport people and parcels to virtually any place on earth. The positive road transport are easy to operate vehicle speed and built a dense infrastructure, hence the possibility of different drive as diesel, gasoline, electricity or biofuels. The biggest negatives of road transport occupation of land for the construction of infrastructure, energy-intensive construction, accidents, gases, noise and dust. Environment directly affect the gases, noise and dust. Gases that are based on car exhausts cause many serious and lasting environmental problems such as global warming, noise manifests construction of noise barriers and thus avoids the natural migration of animals and the impossibility of permanent settlements around man.

Water transport was the invention of the wheel as a more natural mode of transport humans to overcome water obstacles. Water transport is used primarily for freight shipments, which provides the ability to transport huge quantities worldwide. Water transport make up half of the world's transport performance as such. Pros water transport are low energy consumption, little environmental pollution and the use of existing natural waterways. The downside is the low speed of traffic, the low density of the water network in the country, depending on weather and in case of an accident enormous environmental damage.

The original idea of the railway is to enable the supply of industrial raw materials and finished products to take the place of consumption. Construction of the rail network is affected by the surface of the landscape through which it is conducted. The train can not overcome large gradients and sharp curves, so construction is difficult to tunnels, bridges, embankments and cuttings. It builds medium and large distances. Pros rail transport are high transport capacity for medium distances from 100 km, most environmentally friendly mode of transport and the environment (using electricity) and a small portion of land for the construction of infrastructure. The downside is the noise at high speeds, dependence on electricity and construction of infrastructure in land occupation must reckon with access paths and a protective zone.

From the above we can deduce certain criteria for the use of transport modes such as avoiding space in the landscape, demands on energy consumption, adverse effects modes of transport on the environment and external costs.

PREVENTS SPACE IN THE LANDSCAPE

Every mode of transport is not without preventing space in the landscape. Individual species are distinctly different demands on the space occupied in the landscape, both on its own infrastructure and depositing vehicle maintenance and other facilities necessary for the security operation. The most challenging mode to prevent space in the landscape is road traffic. Its claims are clearly seen in cities where cars seized not only all the parking, but also most of the city's streets. The less space then left at public places such as sidewalks, parks, further construction of buildings and other types of urban transport. Each road disembogued directly to the city or directly intersecting the city is flooded with

heavy traffic, which in turn forms an unpleasant steric barrier to humans.

Seizure of space in the landscape road is closed circle. Spatial expansion of road transport in the cities and beyond is characterized by the construction of new roads in the form of a bypass highways. This construction leads to land degradation, prevents space at the expense of nature, creating obstacles for animals and spatial distribution on the corridors.

Compared to road transport, air transport costs, which occupies little space in the landscape. The most visible element is the starting and landing area, and other facilities are built into the surroundings or underground.

Shipping your use of land in the country was taken over by nature. How to change the landscape, varied and watercourses. Human intervention in the landscape only affects the navigability and provide channels for linking directly or in places builds ports.

Rail traffic on the use of land in the country has a much smaller impact than road transport. The basic element of the construction of railway infrastructure monitoring landscape relief to achieve tilt and arc the best possible leadership. In the trend of infrastructure carve underground depots and other facilities necessary for the operation marginalize.

THE DEMANDS ON ENERGY CONSUMPTION

Any means of transport for their movement requires energy. This energy is generated in the drive device. The vast majority of driveline consumes fuel that comes from nonrenewable resources. On a global scale transport consumes about 80% of petroleum products, representing 98% of the energy use in transport. Ten years ago, reaching the consumption of oil for one day operation of transport in the world of 80 million barrels (1 barrel = 159 liters). The International Energy Organization based on statistics estimated consumption trends so that consumption is increasing each year by 1.5%. The most important consumer of transport is road traffic. Its share has been steadily increasing. Guidelines to reduce dependence on petroleum products are basically two. The first way is to develop a new fuel consumption from renewable sources. The second way is to increase the energy efficiency of existing drives for use of logistical planning.

ADVERSE EFFECTS OF MODALITY

Increasing mobility, increasing traffic volumes and performance in road transport are a phenomenon of the past few years. With this inevitably comes also increase oil consumption - a non-renewable natural resources and the amount of exhaust gas, which has a negative effect on human health and on living and nonliving components of the environment. Exhaust fumes contain large amounts of substances that are toxic to health. Some even have carcinogenic and mutagenic effects. Other gases emitted as e.g. carbon dioxide, nitrous oxide or methane long contribute to the increase of so-called. "Greenhouse effect". Thanks transport activity also changes the appearance and morphology of the terrain (eg. Land grab during construction or reconstruction of road infrastructure), transportation networks represent a barrier for migrating wildlife.

Negative also creates noise, vibration and contamination of soil and water due to releases of pollutants from vehicles.

EXTERNAL COSTS

Every nation in the world to use in any way the economic system and evaluates it as transport charges and other related charges. Meanwhile, no economic system is not perfect. Different economic systems in relation to transport are clearly visible transport costs such as fuel price, the price of the vehicle or the price for the work. But there are also external costs, those not directly paid by the carrier, but the whole society. Examples are costs incurred by air pollution, increased noise levels, changes in climatic conditions or environmental accidents. These external costs of transport include expenses such as paying property damage in any form to the treatment of ill-health as a result of negative influences. Generally known facts supported by numerous statistics show that the external costs of air and road transport are very high. The opposite of the waterways and railways, where statistics clearly show the external costs lower.

CONTAINER SPEED TRANSPORT

Global shipments of general transport development characterized by the maximum effort to improve the speed and accuracy of time using modern means of transport, technical equipment and computer technology. The basis of today's transport shipments is the use of combined transport. Combined transport allows secure transport shipments using a single cargo unit from sender to receiver. The most frequently used cargo units are containers and swap bodies.

The container is transported unit standardized according to ISO standards cuboid. The container is used in all transport modes for easy handling in all directions, stacking and standard design elements for fixation.

Swap body is a special unit for shipment. It is slightly larger than the container has the same fixation points as a container. It is equipped with supporting legs for standing and can not be stacked. Transported mainly by road and rail.

DRY CARGO CONTAINER

This container is suiTab. for general use items, is weatherproof. Meets requirements for water tightness. The container consists of a steel frame and corner elements made of cast steel. It is used to transport lump materials, or packaged materials on pallets. In the inner space rings are fastened to fix the material. For loading and unloading are used forklifts, pallet conveyors and pallet trucks.

Tab. 1 Dimensions

kontejner		délka		výška		šířka	
		[mm]	[stop]	[mm]	[stop]	[mm]	[stop]
1C		6058	20*	2438	8	2438	8
1CC		6058	20*	2591	8.5	2438	8
1A		12192	40	2438	8	2438	8
1AA		12192	40	2591	8.5	2438	8
1AAA	**"vysoký"**	12192	40	2896	9.5	2438	8

Tab. 2 Basic dimensions of the container

kontejner ISO:	vnější rozměry v mm (d x š x v)	vnitřní rozměry v mm (d x š x v)
1CC 20 Ft :	6058 x 2438 x 2591	5867 x 2330 x 2350
nosnost: 28 000 kg		
vlastní hmotnost: 2 000 – 2 500 kg		
ložný objem: 30 m^3		
kontejner ISO:	vnější rozměry v mm (d x š x v)	vnitřní rozměry v mm (d x š x v)
1AA 40 Ft:	12192 x2438 x 2591	11998 x 2330 x 2350
nosnost: 26 000 kg		
vlastní hmotnost: 3 500 – 4 000 kg		
ložný objem: 60 – 70 m^3		

Fig. 1 Dry cargo container

OPEN TOP CONTAINER

It has the same construction as universal containers. Only the upper part is not hardtop, but mostly sail, which is part of the container. This container is used for multiple substrates or heavier pieces of merchandise, it is appropriate to dispose the top.

Fig. 2 Open top Container

FLAT CONTAINER

It consists of a solid floor fixed in the corners and also has a folding front wall. This container is used for loading pipes or logs or for shipments not subject to weathering.

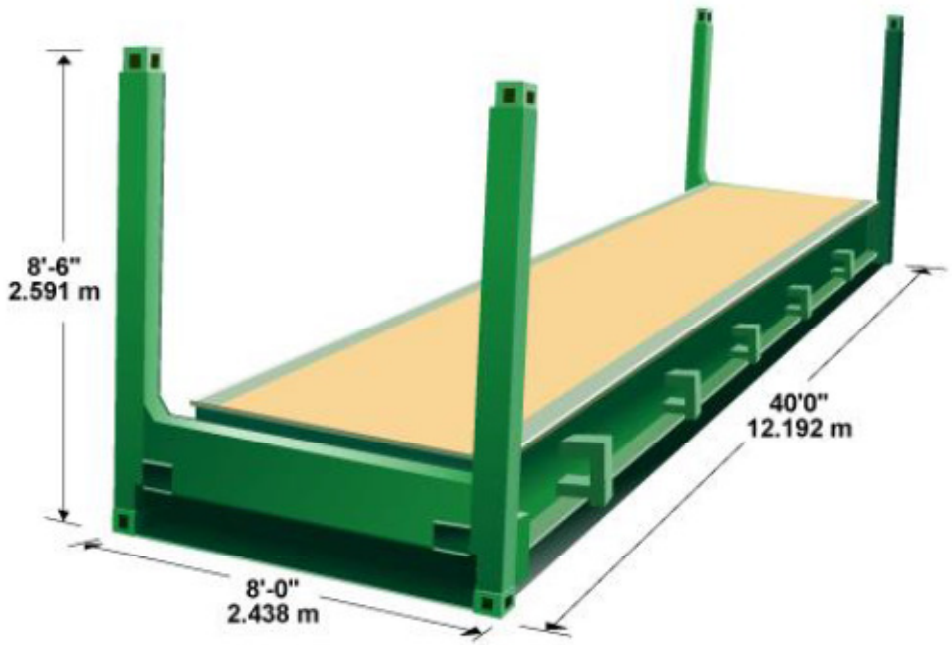

Fig. 3 Flat container

PLATFORM CONTAINER WITHOUT WALLS

It has the same construction as the platform container but contains only the fixed elements in the corners of the eye and fixation consignments for example road vehicles.

Figure 4 Platform container without walls

TANK-CONTAINER

The container consists of a frame structure with corner elements for fixation. Middle frame structure is built in the pressure vessel is cylindrical. It is used for transporting liquids or very fine powdery materials. The volume of the pressure vessel is about 20 cubic meters.

Fig. 5 Tank-containers

BULK CONTAINER

The same construction as universal container only additionally includes on the upper side pouring openings on the bottom of the discharging holes. These holes are used for quick loading and unloading of bulk loose substrates.

Fig. 6 Bulk container

REEFER CONTAINER

Construction is again based on universal container. The walls are made of insulating material and smaller internal dimensions for use in insulation materials. Type by type wall thickness may vary depending on the strength of the insulation. The container includes a unit which ensures a constant temperature inside. When transporting over long distances and can be connected to other suiTab. source of both electricity and cooling directly.

Figure 7 Reefer containers

MEANS OF TRANSPORT

An essential element of each of the transport system and transport consignments means. This resource is used to transport the shipment when it was carrying a loaded loosely or tightly fixed with fixed elements.

The basis of transport for the movement itself is round. This wheel transmits static and dynamic effects during driving and when standing (handling of shipments). It must also be made in the quality required to be capable of supporting the required Bulk Carrier.

The basic around rail transport is wheelset rolling stock. Wheelset rail vehicle provides support and guide rail vehicle on the rail. It consists of a pair of axles and wheels, which axle cold pressed. The force which the wheel is pressed on the axle during manufacture of the molding and recorded this record then used to control the strength of crimp. Molding manufacturing process ensures sTab. wheelbase. When production also makes sure the electrical resistance between the axle. As part of the remedy is also calculated axial locking axle bearings and brake discs. The wheel sets can be connected components drive the generator or the brake components (centrifugal regulator or anti-skid device). Today wheelset diameter ranges between 800 and 1000 mm.

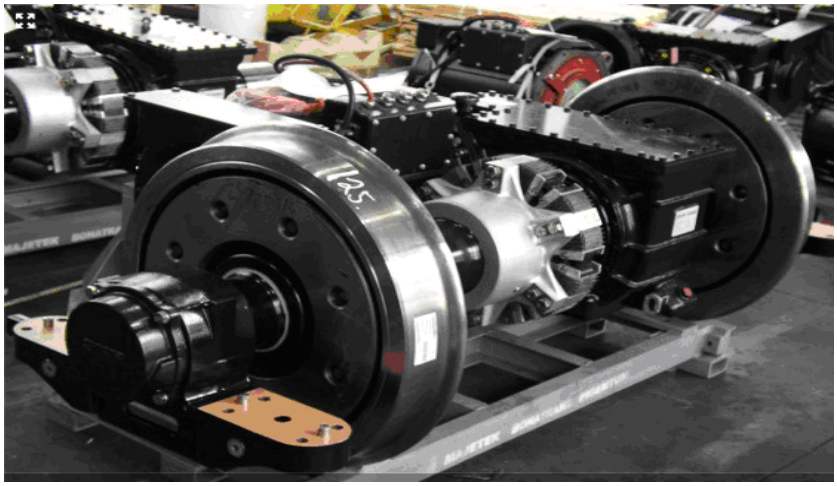

Fig. 8 Wheelset with electric motor

The chassis of a railway vehicle is fitted with a steel frame wheelset. The wheelset is movably connected with the frame. The chassis is attached to the frame of the car itself with the help of the rotary joint. The basic mission chassis ensure smooth running of the vehicle up to the maximum speed with the least wear chassis parts, wheel sets and rails. The chassis is designed to ensure a smooth passage of arc track. It must be just so easy to capacity ratio (bulk shipment) of the vehicle and its own weight as high as possible. To achieve the standards in rail transport varies wheelset load to 22.5 tons. The design and subsequent production shall be addressed to achieve a minimum height above the rail.

Shock suspension and chassis are responsible for preventing the transmission of static and dynamic forces acting between the transport route and means alone. Suspension rail chassis is divided into a primary suspension (between the wheel set and bogie frame) and secondary (between the bogie frame and the vehicle frame). Shock care to further reduce the forces acting on the chassis, suspension that is not able to provide as vrtivý movement or flexible installation wheelset chassis (silencer vrtivého movement or torsion stabilizer).

Claims for the design and construction of the chassis based on various requirements, it is necessary to take into account the type of vehicle used in the operation of the railway line, the existing regulations, standards and economic parameters.

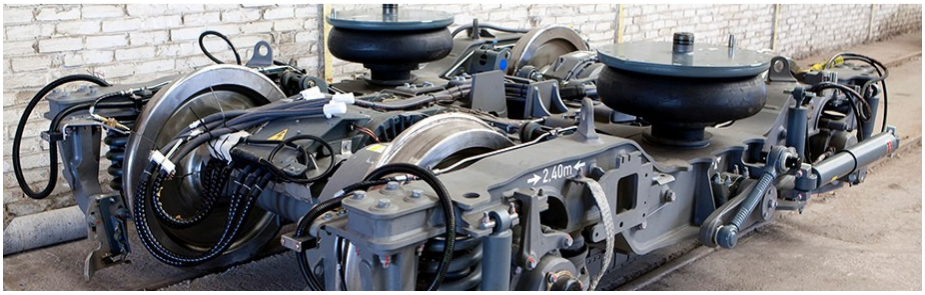

Fig. 9 Chassis rail vehicle

An integral part of every vehicle brakes. The brake is a device that is used to slow or stop a moving vehicle or to hold the rest on the spot. During braking, kinetic energy is converted to another form of energy, and part of the irreversible changes in heat. Ways braking railway vehicles are few. Braking is the most economical recovery. It is the process of converting the kinetic energy of the rail funds back into usable electrical energy into the power system or battery. When recovery is used for braking the electric motor, which in this phase changing to the generator. The easiest way to establish recovery in rail transport is 25 kV 50 Hz. This system is able to power the electric motors to large distances and can encompass recoveries electricity. In this system utilizes the power of three-phase asynchronous motors. Three-phase asynchronous motor will produce electricity back if the angular velocity of the rotating magnetic field is less than the angular velocity of the anchor. Then the anchor is trying to bring its speed rotating field and again acts against the motion.

Another brake used for braking railway vehicles from high speeds is an electromagnetic rail brake. This brake is located between the axles of the chassis, but does not act on it during braking. Electromagnetic rail brake consists of beams and solenoids. Electromagnets attracted by magnetic force to the rail beams, which then act friction force.

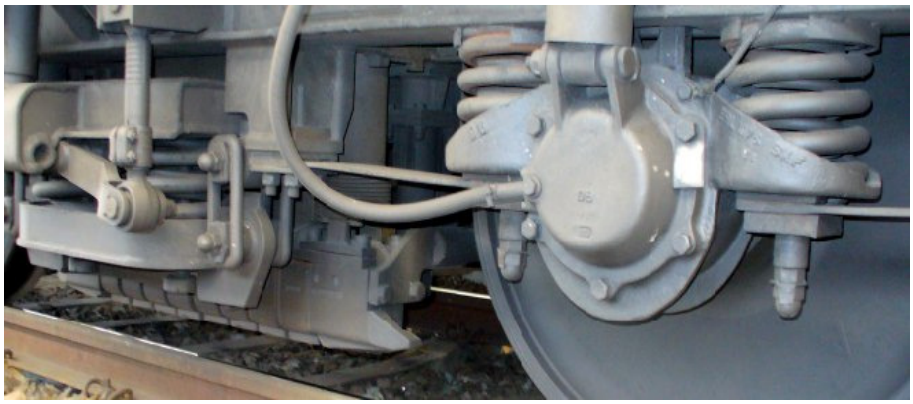

Fig. 10 Electromagnetic rail brake

Disc brake used for braking jaws which pinch brake disc wheelset. The disc is molded by cold wheelset shaft equally on each side. Brake is a modern design and is used both on locomotives and on trailers for its simplicity

Fig. 11 Disc Brake

RAILWAY VEHICLE

For transport of consignments need transport. Today's rail division of resources is planned for the towing vehicle (locomotive), Pulling (trucks and cars) and the other (control, which is used to control other cars). To drive driving vehicles use various druhy.Od produce locomotives used steam, diesel and electric propulsion. The electric motor is most efficient form of propulsion used today. Its advantage is a positive environmental impact, low noise, short-term overload, using almost the entire weight of the vehicle driven by gravity as adhesion during braking and uses the engine as a generator. Disadvantages are due to the high investment costs for the construction of solid traction equipment, dependence on electricity supply and demand on apprenticeship and repair instructions. Towed vehicles are completely without power and is used only for transporting bulk cargo. Combining the towing and towed vehicles can still use more mutual benefits and at the same time will reduce the disadvantages.Flat wagon special design Sgkkmss

Designation of the car based on the international sign for railway wagons. This car is designed for the transport of containers and swap bodies. It is fitted on the frame of the car fixed spines standard size for easy loading and unloading and subsequent provision of container.

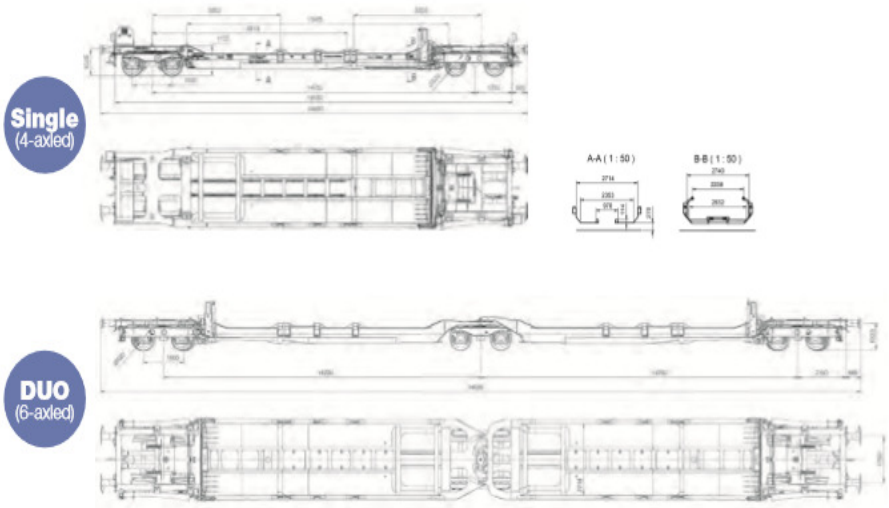

Fig. 12 Diagram railcar

Own the letter indicate that its use

- S - Special wagon chassis construction 4nápravový
- g - designed for the transport of container
- kk - larger loading weight (can be loaded ISO container 1AA)
- m - loading length
- ss - for speed of 120 km/h

Substituting the chassis to the driving axles so there is a railway vehicle capable of hauling containers with minimal labor intensive.

TRANSPORT INFRASTRUCTURE

To railway rolling stock to move needs to be built the way.

The construction of the railway line consists of roadbed and superstructures. Railway substructure is part of the railway or tramway track. The task is to carry the bottom of the track superstructure. The basic ingredient is a natural body accompanied by structural layer of gravel. To enhance the stability is added to the bottom of geotextiles or other geotextile material. The design layer can be additionally reinforced cement or lime stabilization. Do roadbed include embankment, notch, culvert, retaining wall, retaining wall, drains, bridges, tunnels and galleries.

Latest type of rail itineraries (superstructure) is a design using slab track Rheda 2000. This type originated in Germany in Rheda allows a rail vehicle speed of 300 km/h. The actual construction of slab track is being built with great precision, because the additional height adjustment and directional track position is on this construction possible only to a limited extent, a few millimeters. The actual construction is done so. Continuous pouring concrete or prefabricated panels are used in a certain length. Until they are installed special sleepers, which are then encased in concrete. Furthermore, there are used special rail fasteners to allow for additional precision positioning rails. Design of special fasteners replaces flexibility classical track bed has a share to noise reduction in contact wheelset - rails. Further noise reduction is accomplished by using the absorber directly to the rail.

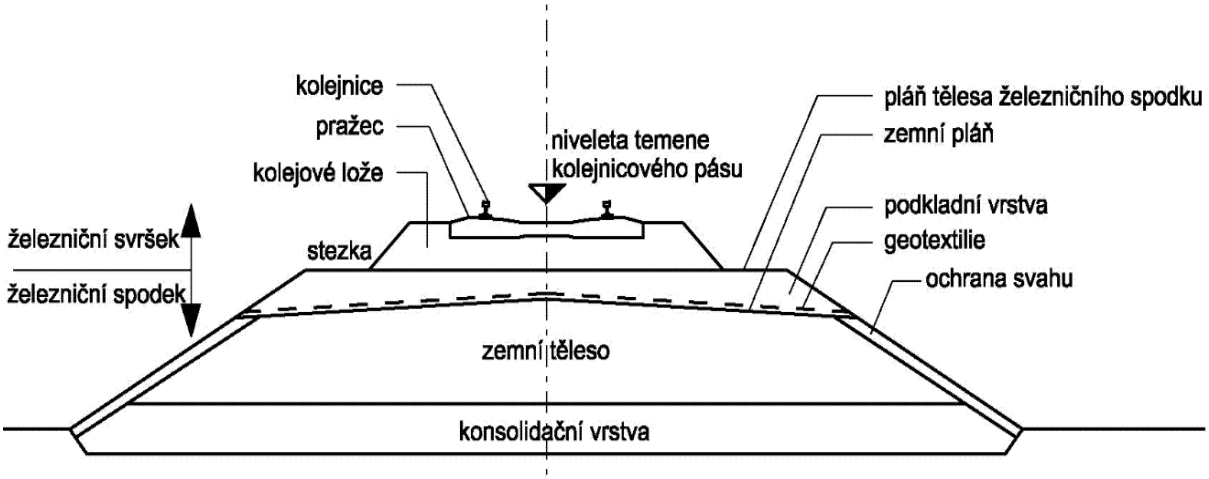

Fig. 13 Construction of rail way

Fig. 14 Fixed carriageway

Fixed carriageway construction is more expensive than conventional railway bed of gravel, but has an advantage that practically maintained. Articulated track is fixed, thus directional stability is achieved and the geometry of the waste and cleaning tamping ballast bed. Adjusting the geometric position happens using shims between -4 mm to +12 mm, directional adjustment for cabling angled inserts in the range of ± 8 mm. The built slab track is then laid rail and fastened with the above fastener. Used rails type UIC 60, which allow operating load D4, which means permit the axle pressure of 22.5 tons wheelset.

Recent structural unit on a solid track represent noise barriers. Elimination of noise associated with the custom driving rail vehicle along the rail. With the development of transport infrastructure on the rail increases the speed of vehicles. Increasing speed also increased noise that bothers mainly in the vicinity of residential areas. Although the population can travel faster and faster shipment can be delivered, but also increases the burden of the population, which translates into reduced psychological well-being or moving (environmental pollution). Noise barriers are very effective solution. Today's technologies allow manufacturers to produce tailored to the type of environment noise barriers of any material and diverse design. The first noise barriers formed by prefabricated panels also prevent the spread of noise in the neighborhood, but had a negative impact on the landscape for its noticeable. Modern noise barriers solve the ills of mainly structural. Structural design directs modern noise barrier directly to the location of the noise, therefore, to the chassis of a railway vehicle.

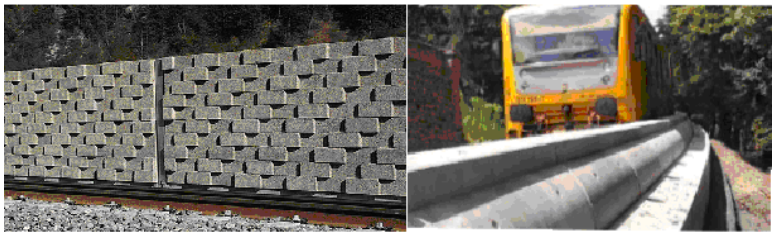

Fig. 15 Old and new construction of noise barriers

For each transport system must be established procedure, which aims to show the effectiveness of own transport process. The Czech Republic has a unique system called Automatic train. Automatic train automation system is designed to automate the management of rail vehicles. This system allows the operator to control the automatic control of propulsion and braking. It is a system capable of aperiodic guide the rail vehicle at a specified rate, maintain the speed with a deviation of 1 km / h, brake target to a designated location at zero speed (stopping accuracy varies with a deviation of 1 meter) and manages the rail vehicle to consume minimum traction energy. The system directly controls the rail vehicle traction control through the use of power and control system in the vehicle.

THE CONTROL SYSTEM OF AUTOMATIC TRAIN

Automatic train control system consists of a fixed part placed in the track and movable parts on the vehicle. On the vehicle transmits only the location information of a rail vehicle on a railroad track (direction of travel, leisure rail section). Other information needed for driving are stored in the system memory (timeTab., route map). This device is also partly dependent on the operator, which gives some parameters (length of the train, braking percentage). The system itself then generates a braking curve for managed service braking. The system itself will then direct rail vehicle on a curve, this curve keeps driving and then fed controlled braking on goal.

Automatic train was created mainly for efficiency. Energy contribution is related to the consumption of traction power and respect of travel time. Man as the operator of the rolling stock is fallible creature and does not always work 100%. Theoretical simulations and experiments in normal operation it is shown that consumption of energy for traction rail vehicle of a certain weight on the track section nonlinearly depends on driving time.

Maximum power consumption is at a minimum (shortest) driving time in extending the running time of several percent in fuel consumption is reduced initially very steep, usually in the order of tens of percent (depending on the particular track section, especially his leaning and gear ratios, and on the type of train mainly on the distance between stops). The timeTab. is incorporated reserve time (usually 4% for passenger trains and 10% for freight trains), whose primary purpose is to compensate for road irregularities (elimination of delays). In the case of the train in time it is possible to use these reserves right to reduce traction consumption reserve of several percent reduction in consumption while allowing tens of per cent. The principle is not to allow movement of the train with a lead, but use the full regular travel time in the track section. A necessary condition for the formation of savings is compliance with train traffic. For delayed train must be cut delay, i.e. to minimize the journey time, which results in maximum power consumption. Driving delayed trains every carrier seeks to minimize. In terms of energy consumption is very undesirable and ride the train with a lead (ie. Before the arrival of the train arrival time specified in the timeTab.). Strict adherence to train traffic during manual control depends primarily on experience train driver, and because the penalties for delay can be significant, as a rule, each driver tries rather ride the train with a slight margin, as it is not considered from the perspective of compliance with train traffic as problematic.

Fig. 16 Fixed part of automatic train

Tab. 3 Specifications automatic train

Základní technické parametry	
Přesnost udržování rychlosti	± 1 km/h
Dráhová přesnost zastavení	typicky ± 2 m
Časová přesnost dojezdu	typicky ± 10 sekund
Úspora trakční energie	typicky 10 až 20 %
Počet řízených vozidel ve vlaku	neomezený

CONCLUSION

System container speed transport using railway infrastructure is able to offer efficient transport. Using known technologies for the construction and transport process is the ability to serve remote areas in a relatively short time and safely with the environment in mind.

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