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TRANSPORT AND COMMUNICATIONS

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Value of Company and Choice of Valuation Method for Forwarding Company

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Abstract The value of company is a very broad concept. Its determination depends on many factors and valuer must take into account both internal and external factors which are affecting the company. In some cases, it is very difficult to decide which of the methods should be used so that the entire valuation is not unnecessarily overpriced for the contracting entity. Valuation also takes into account the resulting objective value. In the case where the choice of method is not determined by the legal act itself, consultation and agreement with the expert is necessary in order to clarify the state of the company and determine the reason for doing the valuation itself. Therefore, the main goal of this paper is to choose an appropriate valuation method for a forwarding company.

Keywords value of company, valuation methods, property of company, profit of company

JEL M41, G32

1. Introduction

The value of company may be determined for a different legal act that affect its outcome. A stand-alone view of a company is made by owners who may want to know the value of the business, for example, for the purpose of selling the company, non-monetary deposit, liquidation of company, or for determining the value of shares in public limited companies. Another view of company have investors, in terms of their investments and its return in the future. Another view can have accountant who works with accounting data and calculates the account value of the company.

It is therefore possible to argue that the value of the company can be differently defined. In the sense of the Commercial Code of Slovak republic, it is defined as “*a set of tangible as well as personal and intangible components of company. To the company belong: things, rights and other property values which belong to the owner of company and serve to operate the company, or because of their nature they serve this purpose.*”[3] For practice, the general value of the company or parts of a company is defined by the laws of Slovak republic in decree no. 492/2004 collection of laws on the determination of the general value of property. The property for the purposes of the decree is being understood as the assets of a company as a whole, part of the company, component of the company’s assets or other assets as a assets of company.

Several methodological procedures based on different principles can be applied in practice to determine the market

value of a company. In this paper, we will focus on the value of a company, which is determined by the experts of the relevant expert departments and their work is guided by the legislation related to the expert activity. [2]

2. Analysis of Current State and Methodology

2.1. General Asset Valuation Methods

A general value in the sense of Decree 492/2004 shall be understood in §2 par. (g) the resulting objective value of an asset, which is the expert estimate of the most likely value of the rated asset on the valuation date at a given location and the time it would have to achieve on the market under the terms of the free market, with caution and with the assumption that the price is not affected by an undue incentive; usually including value added tax. [2]

The value of a business is influenced by a large set of factors that experts should take into account in the process of objectification and integrate them into their calculations. These are internal as well as external factors. Also, the value of a company depends on the purpose for which the value of the company is determined by the expert.

Experts – legal entities (in this paper, an expert is considered to be a legal entity, i.e. an expert organization, or an expert department) use in the experts practice various valuation methods. These valuation methods are defined in decree

492/2004 collection of laws on the determination of the general value of the property. Based on the decree, valuation methods are related to four main principles. [1]

Asset principle – the value of a company is calculated from the value of the individual components of the company's assets from which the value of the obligation is deducted. This principle is mainly used for property and liquidation method.

Revenue principle – in the case of revenue principle, the value of company is determined on the basis of the deductible resources that the company will create in the future. In the decree related to the valuation methods, the revenue principle is used in the business method.

Combined principle – principle combines asset and revenue principles. In the decree, a combined method is based on this principle.

Market principle – its basis is to derive the value of a company from the value of a similar company on the market. In our legislation on this principle works comparative method. In practice this method is minimally used.

The most used methods in the expert's practice are property and business methods. [1]

The advantages of the **property method** is that the owner of the company besides the value of the company itself also obtains information about the value of specific components of assets and liabilities individually. This is very desirable, for example, if it is necessary for account purposes to determine the fair value of the individual components of the assets and liabilities of the acquired or merged company. Furthermore, this method is used when the business owner does not have a clear business intention, or if the business plan does not relate to the historical development of the company, or if the company is showing a loss. The disadvantages of this method is that the method is time consuming, labor and financial difficulty. It is necessary to perform an asset inventory on the valuation date, to analyze in detail the individual components of assets and liabilities together with all the specifics. At the same time, it is necessary to create a team of experts from relevant expert departments who are authorized to determine the value of individual specific components (for example, road vehicles, machinery, trademarks, construction, specific software, etc.), which is ultimately costly for the owner of the business. The property method does not take into account the revenue potential of the company. For example, it is not appropriate if an owner of a company provides services, or rents other property.

The **business method** is the most commonly used method for determining the value of a company. It is especially used when the owner of the company needs to know the value of the company which he is about to sell. The advantage of this method is that it takes into account the revenue potential of the company and is less demanding on labor compared to the property method. By this method, an entrepreneur acquires information about the value of the company as a whole, but does not recognize the value of the individual components of assets and liabilities, so it is not possible to use this method if the steps of the legal require all components of assets and

liabilities to be recognized in the expert's report. In the business method, the expert uses the financial plan of the company, which is submitted by the company. The expert must examine the reality of the financial plan by elaboration of financial and economic analysis. The method is also appropriate for determining the value of a company when an investor invests into a company, because it takes into account the company's revenue potential – future earnings.

The decision taken by the expert in the field of choosing the right method for valuation of company's property, depends on the overall structure of the company, the revenue potential of company, submitted documents and on the purpose for which the valuation is being made. The choice of the appropriate method is also influenced by the sector in which the company carries out its activity and its object of activity. Different structure of assets and liabilities has a company that only provides services and different structure has a manufacturing company. In the following sections of the paper, we will deal with a problem of determination of a value of a forwarding company which operates with freight road transport.

3. Results

3.1. Definition of Forwarding and Transport Service Provider

According to Moravčík (2008) *“Forwarding in today's modern economy has long been not just transport procurement. Forwarding is referred to as one of the stages of outsourcing (so called third level outsourcing), with individual levels differing from one another to the extent and complexity of the provided services. At the same time, the forwarder becomes more and more logistic and is a fully-fledged and often very important element of the logistics chain, and its services can sometimes create the entire basic logistics piece of distribution logistics”*.

The basic legal document in the forwarding service is the conclusion of the forwarding contract. This contract is concluded by the forwarder and the customer who orders shipment of goods. The forwarding contract expresses the obligation of the forwarder to obtain the transfer from a certain place in a specific another place. The customer – payer commits to pay the forwarder the payment. The definition shows the relationship between the parties involved in the commercial-shipment relationship. The forwarder carries out the transport in his own name, which means that he, in his own name deals with the carrier. He also, on his own behalf concludes a transport contract with the carrier. The forwarding contract therefore governs exclusively the business relationship between the forwarder and the ordering party – the customer. The carrier does not take a part in the forwarding contract. In the case of procurement of transport via the forwarder, this relationship is governed by a contract of carriage, where the relationship is between the forwarder and the carrier. The customer, who ordered the transport does not take a part in this contract. [6]

According to Gnap (2018) *“the priority task of forwarding and transport companies is to transport goods at the right*

time, at the right place, in the required quality and at the appropriate price, according to the customer's requirements. At a time when production cooperation has progressed as far as today and business chains operate around the world, it is not usually a simple task. The customer order cycle is shortened and e-commerce is increasingly rising, which means that new roles are beginning to emerge for the transport and forwarding companies. These are also the reasons that lead to an ever closer linking of forwarding and logistics."

3.2. Features of Forwarding Company in Relation with Valuation Methods

Forwarding is related to the provision of specific services. Most companies, however have several subjects of activity, so choosing the right method is always a consideration of the expert in the field of company valuation and also a company whose property is being valued.

As an example we can list randomly selected company. This company was established in May of 2015. The company's main activities focus on freight forwarding and operation of road freight transport. Company also has the following activities, for example: purchase of goods for sale to the final customer, lease of movables and mediation of activities in the field of trade, services and production, implementation of extraction services, tow services, provision of services for the management of a foreign motor vehicle, courier services, storage, packing, administrative activities, advertising and marketing services, rental real estate associated with the provision of non-essential services related to renting, implementation of extra-curricular educational activities, forwarding, diagnostics and repair of road motor vehicles, profession of freight operator for road transport. [4]

Table 1. Assets statement

Year	2017	2016
Assets	980 736	677 476
Non-current assets	638 688	543 378
Long-term tangible property	638 688	543 378
Current assets	334 300	130 811
Inventory	2 408	4 431
Short-term receivables	331 009	117 862
Financial assets	883	8 518
Costs of future periods	7 748	3 287

Source: [5]

For the purpose of the effective performance of its activities, a company must own non-current assets, moveable assets for the execution of the tow service, diagnostics and repair of road motor vehicles, and in particular the occupation of the operator of road freight transport. The tables listed below were made according to the annual financial statement of the fictional company. Accounting data, for the demonstration were gathered from the actual company that operates in the similar field of activities as the fictional company we

created for this paper. The data were gathered at the central register of the financial statements of the Slovak Republic. Within the tables 1-3, asset structure on the side of assets and liabilities structure on the side of liabilities for the year 2017 and previous fiscal year 2016, have been compiled. Values in the tables are in net worth. [5]

The financial statement (table 1) shows, that non-current assets are represented in a higher proportion than current assets. All non-current assets are self-movable items and sets of movable items, which in 2017 can be seen to increase in comparison with the previous period. This increase is necessary to ensure the securing of business operations of the company. No real estate property is reported, which means that the company operates from the rented space. Current assets are mainly represented by the short-term receivables. Financial assets are money in the treasury and bank accounts that are likely to be a bank overdraft due to the balance on the bank account as no credit is reported for the previous period as at 31 December 2017, but interest expense is recognized in the income statement.

Table 2. Liabilities statement

Year	2017	2016
Liabilities and equity	980736	677476
Equity	56 998	44 797
Liabilities	923 738	632 679
Long-term liabilities	573 865	491 211
Short-term liabilities	346 465	139 435
Short-term reserves	3 408	2 033

Source: [5]

As we can see in table 2, the company has high liabilities (in 2017, 923 738 €) in proportion to the total assets of the company (in 2017, 980 736 €). In net worth, the balance of assets and liabilities is almost balanced. Company has very high long-term liabilities from trade (in year 2017, 573 865 €). To a lesser extent, short-term liabilities (total amount in 2017: 346 465 €), which consist mainly of trade liabilities and liabilities towards company associates. The company shows positive equity (in the period which we reviewed, even in the past years, the company had a profit), the ratio of own and foreign capital is significantly on the side of foreign sources, which shows a high indebtedness.

When we look at the income and loss statement (table 3), it can be seen that the overall economic result is affected by the financial performance of the financial activity, where the loss is mainly due to the cost of interest which is a part of cost of financial activities (in 2017, in amount of 10560 € and in 2016 in amount of 8 613 €). The loss from financial activity is very high in proportion to the company's result of economic activity. Economic activity achieves positive results and has a growing tendency compared to the previous period. The company has high net turnover mainly due to the forwarding services it provides (in 2017, 1 144 182 € and in

2016, 605 580 €), which have increased significantly over the previous period.

Table 3. Income and loss statement

Year	2017	2016
Net turnover	1 144 182	605 580
Revenue from economic activity	1 164 946	608 218
Cost of economic activity	1 133 114	585 460
Profit / loss from economic activity	31 832	22 758
Revenue from financial activity	7	5
Cost of financial activity	16 348	11 239
Profit / loss from financial activity	-16 341	-11 234
Income tax, payable	3 290	2 880
Profit / loss for the period after tax	12 201	8 644

Source: [5]

According to another data in the income and loss statement the profit or loss from economic activity is particularly influenced by services (in 2017, 545 026 € and in 2016, 216 059€), depreciation of fixed assets (in 2017, 207 471 € and in 2016 88 239 €) and material and energy consumption and other non-storable deliveries (in 2017, 302 002 € and in 2016, 216649 €). A smaller portion consists of personal expenses, taxes and fees and other costs.

4. Recommendations and Conclusion

From the point of view of future development, we can see the assumption of the company's revenue potential, as the monitored company is in terms of the life cycle in the growth phase. From the expert the point of view, it is possible to apply the asset as well as the revenue principle. The decision to use a particular method largely depends on the purpose, i.e. from the legal act for which the expert's act is to be performed. It is also important to note that the value of a company is set at a specific date, in this case it is the end of the year when the financial statements are made and is also used for tax purposes. During the year to another valuation date, the book values will be reported to others. In this case, as if

December 31, 2017, in view of the growth phase of a company, it would be appropriate to use the revenue principle and asset principle combined. If it is necessary to select only one method, it is advisable to lean toward the revenue principle. The asset principle is risky in terms of asset structure and proportion of liabilities. According to the financial statements, it cannot be ascertained in what physical condition the movable property is. The state of the receivables is not known, even though the company is not long on the market. Receivables can be also 2 years after the maturity, or the clients can be in bankruptcy or liquidation, which significantly affects the value of receivables in the negative direction. Everything depends on the specific role of the expert and for what purpose the expertise needs to be used.

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Identification of the criteria determining the attractiveness of post offices in city Zilina

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Abstract Customer's preferences in the choice of a particular device is in many cases due to the attractiveness of this device. This means that customers are willing to travel longer distances to larger business centres with higher attractiveness. This is also the case for postal offices. Because postal operators are trying to maintain their customers, they also have to respond to these criteria that determine the attractiveness of the device providing of the required postal services. However, the attractiveness of the device can be perceived differently by customers. Therefore, the aim of the article is to find out these attractiveness criteria for individual post office customers, which in the future can help in selecting sites for the next post-creation or revocation of an existing mail.

Keywords availability, attractiveness criteria of post offices, marketing research

JEL L87, M31

1. Introduction

The postal market is a very specific sector of the industry. Therefore, it is more demanding to keep customer loyalty despite the innovations and opportunities that the current means of information and communication technologies allow. Nowadays, the message can be sent electronically and, therefore, we as humans start to slowly forget about the traditional sending of letters which is time and financially more demanding than, for example, regular e-mail. On the other hand, as the volumes of letters decline and the amount of the packages sent increases, it is necessary to adapt to this trend. In the postal market, there is a great deal of competition between individual postal operators. Also, it causes more significant issues to react and adapt to current trends to universal providers of postal services as they are facing the higher legislative demands.

Every business providing universal postal service is obliged, to a certain extent, to ensure the availability of postal services in the defined area for individual customers. However, this availability may not be consistent with the real needs of the customers of the postal company in a particular territory. For these differences, it is necessary to identify customers' requirements and align them with the setup requirements for the availability of postal services, resulting in the satisfaction of both parties.

2. Background

In general, availability indicates the potential of interaction opportunities. Similarly, it is possible to mention the easiness of spatial interaction or potential contact with the activity or the offer, or the attractiveness of a point in the network, given the number of additional points and the cost of achieving these points over the system. [1] Availability is specific to the type of user and the purpose of the communication. Different interpretations of the concept of availability are possible. Accessibility was first perceived only as a physical measure, but with time being based on practice needs, accessibility was also perceived as a concept of utility and potential opportunity. Among the most significant work on accessibility, which is a useful and potential opportunity, it is possible to include a study by Jones, who in his paper from 1975 analyses availability in terms of satisfying needs [2], and by Hodgart, which provides scenarios for addressing issues of location of civic amenities based on availability measurements. [3]

Availability in the postal sector is defined from two different points of view, time-related and space-related. Time availability refers to the number of days in the week when the postal service is provided, as well as the timetable for the public in brick and mortar postal places. Spatial availability reflects the density and distribution of postal network access and contact points, for example also post offices [4] The issue of the spatial accessibility of the postal service, or post

offices in the network of postal operator was researched by, for example, Krizan, who together with Tolmaci in 2008, evaluated the availability of post offices in the city of Bratislava in the network of urban public transport, the road network and the pedestrian network through perceptible accessibility rates. [5] Furthermore, Madlenak et al. in 2016 points to determining the optimal location and deployment of postal offices through allocation models. [6] Spatial accessibility of postal services or postal units located within the postal network in 2018 was also focus of Mostarac together with Kavran and Feleter, who in their studies analysed the availability of postal facilities according to the current criteria for determining the density of access points in the Republic of Croatia. [7]

3. Aim

The spatial availability of the postal service for the user (customer) is generally one of its most important quality characteristics. The customer perceives this accessibility as an opportunity to use the required postal service at the branch of the postal company that is the most attractive to him. The attractiveness of premises providing postal services can be perceived differently by customers. This means that the customer chooses a facility located either in the territory near his / her residence, in the area where he/she is most often resident, in the area where nearby shopping centres or facilities are providing other communication services such as for example transport services. By these criteria determining the attractiveness of the individual postal facilities, it is possible to optimize the postal network within the defined territory, which each post operator is striving to do. This is mainly because availability is also associated with extra costs, as are staff costs and the cost of renting very limited used post offices. Therefore, this article aims to identify criteria that determine the attractiveness of the individual postal facilities regarding the customer, namely in the town of Zilina, to avoid unnecessary expenses in this defined territory.

4. Data and methodology

Information on criteria and requirements determining the attractiveness of service providers can be obtained through the systematic search, collection, processing, analysis, and presentation of the necessary information called marketing research. [8] This complex process of gaining knowledge about the particular situation is based on a couple of essential steps. These steps are to define a research problem, to determine the research goal, to set up research assumptions, orientation analysis of a situation, methods and techniques of data collection, determination of sample size, data collection, processing and data analysis, presentation of research goal. [9]

4.1. Determining the research problem, goal and assumptions

The research problem of the presented marketing research is to identify the criteria determining the attractiveness of the access and contact points of the public postal network of the universal postal service national provider from the customer's perspective in the town of Zilina. Access points and contact points of the public postal network are not only post offices buildings but also mailboxes, self-service facilities, mail employees and other places designed to collect or deliver postal items. [10] To specify within this marketing research, we have identified as the postal access and contact points of the public postal network that understands only the post offices of a national universal postal service provider. Following this problem, we set out two fundamental research objectives:

1. Finding the criteria determining the attractiveness of post offices in the town of Zilina from the customer.
2. Finding the current state of spatial availability of post offices in the town of Zilina.

The research prerequisites that we subsequently worked on into details and verified in our marketing research are:

- At least 1/2 of respondents will consider an attractive post office location within the centre of Zilina where a particular branch of the post office is located.
- A minimum of 1/3 of respondents will prefer post offices located near parking facilities compared to branches without parking facilities.

4.2. Orientation analysis of the situation

Within our orientation analysis of the situation, we have found that attention has been already paid to the issue in various works, but only marginally. None of them considered the identification of the specific criteria of the post office's customers determining the attractiveness of individual post offices in the city of Zilina. Therefore, the required information was to be obtained through primary research. The target group of marketing research is a sample of 81,041 inhabitants of Zilina (December 31, 2016), who are also the core and primary sample for our study. The minimum number of respondents required to obtain the results of the study with the maximum tolerable error range indicating the tolerated error amount that we set to ± 0.05 was unknown to us and had to be calculated. Next, we worked with 95% reliability, which has a table value of 1.96 and tells us how confident we can be with assumptions, and also with the variability of the basic set p with a set value of 0.5 from which we can further calculate the value of the standard deviation also set up to 0.5. In this research, the three-category data processing was developed. As a criterion for quota selection, we chose the distribution of the population of Žilina by gender, age and education. By age, we divided the town's population into six categories: up to 25 years including, up to 35 years including, up to 45 years including, up to 55 years inclusive, up to 65

years inclusive, 66 years and over. By education to primary, secondary and university education.

4.4. Determination of sample size

To calculate the minimum sample size of the respondents, we used the following formula:

$$n = \frac{N * t_{1-\frac{\alpha}{2}}^2 * \sigma^2}{(N-1) * \Delta^2 + t_{1-\frac{\alpha}{2}}^2 * \sigma^2} \tag{1}$$

where N is the basic set of research (81 041 inhabitants of Zilina), $t_{1-\frac{\alpha}{2}}^2$ represents the table value for 95% reliability, parameter p represents the variability of the basic set, Δ is the maximum allowable error range, and a parameter of σ represents deviation calculated according to the formula:

$$\sigma = \sqrt{p * (1 - p)} \tag{2}$$

Based on the above formulas, the minimum number of respondents resulting from the population of the town is 383. Before the collection of primary data by electronic query was conducted, the questionnaire was pre-tested on a sample of 15 respondents. In the pre-test, the most frequent answer was found. Therefore the number of respondents changed to 210, representing a representative sample of the inhabitants of Zilina.

5. Result

A total of 225 respondents were involved in the research, out of which seven questionnaires were rejected because they were inadequate regarding knowledge of the locations for post office buildings in Zilina. The remaining 218 respondents were 130 female and 88 male. The highest number of respondents had completed a secondary education - 123, a university education got 85, and primary education was mentioned by 10 respondents. All 218 respondents were aware of the location of at least two post offices in the town of Zilina. Another parameter of quota selection affecting respondents in choosing a more attractive post office was the age structure of respondents, which represents the following data: up to 25 years - marketing research included 98 respondents, up to 35 years we counted 50 respondents, up to 45 years 19 respondents, up to 55 years 27 respondents, up to 65 years, 17 respondents and 7 respondents were 66 years old or older.

5.1. Presentation of research results

When questioning the attractiveness criteria that affect customers in selecting a particular post office, respondents had listed five types of options that could be expressed based on a range of values from 1 to 5. The values on the scale represented as follows: 1 - it affects the most, 2 - it is influential, 3 - no influence, no effect, 4 - slightly does not affect and 5 - does not affect at all. The individual data collected are shown in the following Table 1.

Table 1. Attractiveness criteria of post offices

Attractiveness criteria	Value scales				
	1	2	3	4	5
Location of post office in the city center	93	63	38	11	13
Barrier-free access	36	73	56	24	29
Proximity of the stop of the transport services	57	79	45	15	22
Proximity of parking spaces	46	79	37	21	35
Proximity of shopping centers, hospitals, pharmacies, offices, ...	27	62	75	20	33

The answers given in this question were used to validate, respectively reject the research prerequisites and goals we set for our marketing research.

5.1.1. Presentation of the results of research assumptions

For the first research prerequisite, we have determined that at least 50% of respondents will consider the attractive location of post offices within the centre of Zilina where a branch of the post office is located, we have confirmed it. Taking into consideration the three-category processing, we got these results.

Women with completed primary education stated that three of them aged under 25 and one to 45 years feels affected by a location very much, one woman under 25 founds this allocation influential, and one woman also under the age of 25 stated that branch allocation does not affect her at all. The number of women with completed primary education was six.

The figures presented by women with completed secondary education of 74 women are shown in Figure 1.

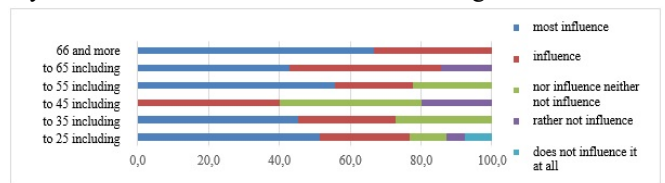


Figure 1. Results of the first research precondition for women who have completed secondary education.

The assumption most affects as follows: 6% of women over 66 years, 9% of women under 65 years, 14% of women up to 55 years, 14% of women under 35 and 57% of women under 25. The allocation of the post office branch affects 4% of women aged over 66, 14% of women under 65, 10% of women under 55, 10% of women under 45, 14% of women under 35, and 48% of women under 25 years. Rather, it does not affect women under the age of 65 and up to 45 for one in each category, and for two women under 25. Three women under the age of 25 do not feel affected by this at all.

Opinions of women with a completed university education, there were 50 of them, are shown in Figure 2.

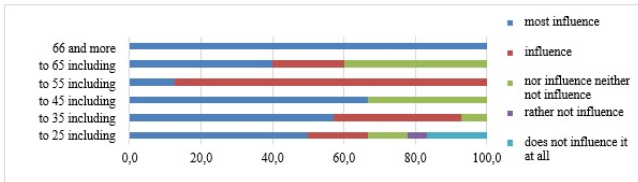


Figure 2. Results of the first research precondition for women who have completed university education.

This assumption affects the most 8% of women over the age of 66, up to 65 and up to 45 years, 5% of women under 55, 33% of women under 35 and 38% of women under 25 years of age. The allocation of the branch affects 6% of women under 65, 44% of women under 55, 31% of women under 35, and 19% of women under 25. The allocation of a branch slightly does not affect a woman under the age of 25. Three women under the age of 25 are not affected by this parameter at all.

The men with completed primary education stated that one of them under the age of 25 years feel extremely affected by the allocation of a branch, one male up to 45 and one male over 66 feels affected by this allocation, and one man aged 25 or under, have felt indecisive when considering branch allocation criterion. The number of men with completed primary education was four.

The figures quoted by men with completed secondary education in the amount of 49 is shown in Figure 3.

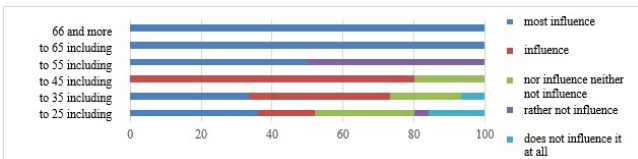


Figure 3. Results of the first research precondition for men who have completed secondary education.

The assumption does most affect 6% over the age of 66, 65 and 55 years, 29% of men under 35, and 53% of men under 25 years of age. The branch allocation affects 29% of men under 45, 42% of men under 35, and 29% of men under 25 years of age. Rather, it does not affect men under the age of 55 and up to 25 years of age one for both age ranges. Four men under the age of 25 and one under 35, feel not affected at all by the allocation of post office branch in centre of town.

The data obtained by men with completed university education in the amount of 35 are shown in Figure 4.

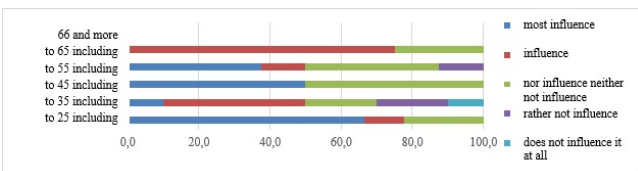


Figure 4. Results of the first research precondition for men who have completed university education.

Allocation of the post office in the centre most affects 25% of men under the age of 55, 17% of men under 45, 8% of men under 35, and 50% of men under 25. The allocation of the branch affects 34% of men under 65, 11% of men under 55, 44% of men under 35, and 11% of men under 25 years of age. Rather, it does not affect men under the age of 55 and up to

35 with one and two men for selected age categories. One man under the age of 35, when considering the allocation of post office branch within centre, feels not affected by it at all.

The allocation of post office branch in the centre really affects 63 women, partially affected there are 38 women, 17 women have not been able to decide, 5 women do not feel affected by this assumption, and 7 women from 130 women do not feel affected by it at all.

The allocation of post office branch within in the centre affects the most amount of 30 men, partially affect a total of

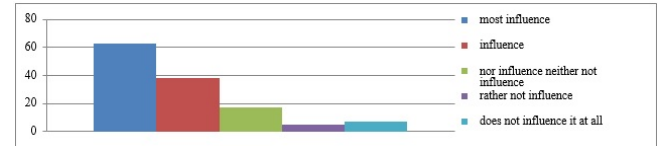


Figure 5. The first research assumption for women from 130 women.

25 men, a total of 22 men were not able to make a clear decision, 5 men do not feel rather affected by this allocation, and 6 men out of 88 men do not feel affected at all.

It shows that up to 78% of customers choose a branch based on its allocation in the territory, which suggests and

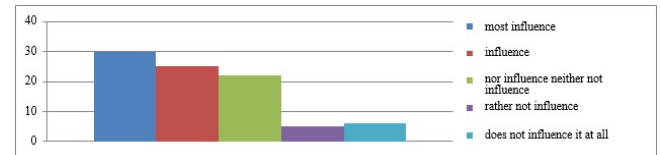


Figure 6. The first research assumption for men from 88 men.

confirms that our **first research assumption was correct.**

In the second research assumption, we have determined that at least 35% of respondents will prefer post offices located near parking places compared to branches without parking spaces. The results of this assumption are shown in Table 2 for women.

Table 2. Results of the second research assumption for women

Education	Women																	
	Basic					Secondary					University							
Age	Together	1	2	3	4	5	Together	1	2	3	4	5	Together	1	2	3	4	5
to 25 including	5	20	40	0	0	40	39	10	33	21	15	21	18	22	22	11	11	33
to 35 including	0	0	0	0	0	0	11	18	55	18	9	0	14	36	43	0	0	21
to 45 including	1	0	0	0	100	0	5	20	60	0	20	0	3	33	0	33	0	33
to 55 including	0	0	0	0	0	0	9	22	44	22	11	0	8	13	63	25	0	0
to 65 including	0	0	0	0	0	0	7	14	14	29	14	29	5	20	80	0	0	0
66 and more	0	0	0	0	0	0	3	0	33	0	33	33	2	0	100	0	0	0
Together	6						74						50					

The results of second research assumption are shown in Table 3 for men.

Table 3. Results of the second research assumption for men

Education	Men																	
	Basic					Secondary					University							
Age	Together	1	2	3	4	5	Together	1	2	3	4	5	Together	1	2	3	4	5
to 25 including	2	50	0	50	0	0	25	16	32	20	8	24	9	22	11	44	22	0
to 35 including	0	0	0	0	0	0	15	20	33	33	0	13	10	20	30	10	20	20
to 45 including	1	0	0	0	0	100	5	60	40	0	0	0	4	50	25	25	0	0
to 55 including	0	0	0	0	0	0	2	50	0	0	50	0	8	38	63	0	0	0
to 65 including	0	0	0	0	0	0	1	100	0	0	0	0	4	25	75	0	0	0
66 and more	1	0	0	100	0	0	1	0	0	0	0	100	0					
Together	4						49						35					

The values given for the 1 to 5 scale scores for specific age based on education are provided as a percentage of their relative abundance. Gaps with a value of 0 mean that the criterion does not have a respondent.

The scale for a Table 2 and 3 represent values from 1 to 5. The value 1 is for the respondent the most effective, 2 affects the respondent, 3 nor affects neither does affect the respondent, 4 rather does not affect the respondent, 5 does not affect the respondent's opinion at all.

As a result, in overall, men and women are affected by the proximity of parking spaces to 63% and therefore **the second research assumption was also correct** as the value exceeded expectations.

5.1.2. Presentation of research goal

The first set research goal was to find out the criteria determining the attractiveness of post office in the town of Zilina from the customer. According to the multi-attribute procedures, which give the values of customer importance and their subsequent analysis, a global perspective is created [10], we find out that the criteria that influence customers the most when choosing a more attractive branch are the allocation of post office with the index of 3.83 and the presence of the bus stop with an index of 3.61. Followed by option with a parking lot with an index of 3.37, access to a post office with an index of 3.29 and civic amenities with an index of 3.13. The scales 1-5 had weighted values in the reverse order, i.e., 5-1. This means that the criterion that most affects customers has the highest index.

The second research objective was to find out the current state of spatial availability of post offices in the town of Zilina. Based on the research it can be stated that the space accessibility of the post offices in the town of Zilina is bordered by the evaluation of level good. This is because specific post office branches locations are somewhat less attractive than others. These are mainly the post offices in Vlčince (Post office 8), Solinky (Post Office 7) and the customers lack the post office for the settlements of Hliny and Borik, which in the past were covered by the Post Office 6.

6. Conclusions

In regular life, purchases and customer visits are influenced by a variety of criteria that have a different impact on customers. The aim of this article was to identify these criteria and increase the traffic of certain facilities providing postal services in the city of Zilina. Criteria influencing the traffic of individual post offices in Zilina were obtained through marketing research. These criteria can also be considered as criteria for the attractiveness of the post. Based on

the results of our research, we can state that the most attractive are the mail that is in the city centre. This means that customers are more likely to visit post offices in the city centre where they can also provide other required services.

The criteria to determine the attractiveness of post offices from the customer's point of view can serve as a basis for improving the strategic deployment of Slovak Post offices that are already in existence. For the future if the population of Zilina has increased, the result would affect the number of post offices also resulting from the Postal Services Act.

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Financial Health Assessment of International Airports

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Abstract The financial health of company is extremely important for potential investment decisions. Financial health is mainly assessed by financial analysis which identify strengths and weakness. The aim of paper is to evaluate and to compare financial health of selected international Slovak and Czech airports. We applied the best-known financial variables, particularly liquidity ratios, asset management ratios, debt ratios and profitability ratios. Then, we compare results of Bratislava Airport with Kosice Airport, Ostrava Airport and Prague Airport. We calculate financial ratios based on statements of international airports. The results show that Bratislava Airport is mainly good at current assets management during analysed period. On the other hand, Bratislava Airport have long-term problem with profitability ratios.

Keywords Financial Analysis, Financial Health, Financial Ratios, International Airport, Liquidity Ratios, Asset Management Ratios, Debt Ratios, Leverage Ratios

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1. Introduction

Financial analysis is a tool for decomposition of financial statements. The aim of financial analysis is to obtain an overview about assets and capital structure in enterprise. Based on the result of financial analysis we can make investment decisions. Moreover, financial health expresses resistance to external and internal risks. Enterprises can achieve optimal financial conditions, for instance, based on adequate liquidity and profitability ratios. The fulfilment of these attributes enhances the increase of company market value [1, 2].

2. Literature review

The financial situation of company is determined by several factors. The impact of these factors is shown by ratio variables. Most of these ratios have comprehensive character.

The primary aim of financial analysis is not only to calculate ratios, but mainly find out how partial ratios have impact on comprehensive situation of enterprise. The relationship among ratios may have additive, multiplicative or mixed character [3]. The influence of partial ratios on comprehensive ratios can be quantified by specific methods applied in the financial analysis, for instance, logarithmic method, functional method, etc.

The assessment of financial health is conducted through specific method, i. e. financial-economic analysis. In general, methods are divided into two main groups - elementary and sophisticated methods. In this paper, we focus on elementary

methods. The elementary methods include analysis of absolute indicators that are part of horizontal and vertical analysis. However, we concentrate mainly on liquidity ratios, asset management ratios, debt ratios, profitability ratios and market ratios.

The elementary tools of financial analysis include ratio variables that express relationship among two and more absolute variables. The primary advantage is to eliminate the disadvantages of absolute variables that is not available to provide reliable information. The reason is different size of enterprises. On the other hand, their primary disadvantage is that the ratios variables have reduced explanatory ability. Therefore, we must compare ratios of selected enterprises with recommended variables, planning variables or variables from previous years [13]. The elementary ratio variables include liquidity, asset management ratio, leverage ratios and profitability ratios [4].

Liquidity means company's ability to pay current liabilities. Liquidity ratios are important for creditors. It is associated with potential insolvency of business partners. In general, the liquidity ratio is relationship between current assets and current liabilities. The business partners believe in enterprises with greater level of liquidity ratios. Liquidity ratios depend on liquidity level of asset. On the other hand, too high level of liquidity ratios has negative impact on profitability. It is reason why liquidity ratios have recommended intervals [14].

The liquidity ratios include Cash Liquidity, Quit Liquidity and Current Liquidity. In addition, among liquidity ratios belong, for instance, Relative Ratio of Net Working Capital

(NWC) that reflects ratio of NWC to Current Assets. The recommended level is from 30 % to 50 % [15].

Asset management ratios measure enterprise effectiveness. Low asset effectiveness causes to increase costs due to maintenance assets, for instance, inventories or repayment of interest on loans for purchase of given asset. Therefore, enterprise has assets surplus. On the other hand, for company is acceptable nor lack of assets. It causes slowdown of production and decrease of sales revenues [16].

The specific asset management ratios are Days Sales Outstanding and Days Payables Outstanding. These ratios indicate quality of relationship between suppliers and subscribers. Results of these ratios determine lack of cash, for instance, if receivables maturity is longer than liabilities maturity. In addition, among asset management ratios belong Assets Turnover Days, Non-Current Assets Turnover and Tangible Assets Turnover Days.

Debt Ratios are associated with funding asset structure in enterprise that represents equity and liabilities. The primary reason of use of external resources, for instance, bank loans is relatively lower price compared to price of own resources. It is associated with tax shield. Debt Ratios don't have recommended limits, i. e. company looks for optimum ratio between own resources and liabilities. It is clear that high level of total debt has negative influence on profitability and liquidity ratios in enterprises. Among basic debt ratios belong Debt Ratio, Credit Debt Ratio, Financial Leverage Ratio and Interest Coverage Ratio.

Total Debt to Total Assets reflects ratio debt to total assets. The sum of Total Debt to Assets and Equity ratio equal to 1. Equity Ratio reflects ratio equity to total assets. Both ratios are important to lenders and owners because enterprise shows dependence on external resources. Debt ratios include Financial Leverage Ratio, Interest Coverage Ratio, etc. In addition, Interest Coverage Ratio reflects the enterprise's ability to pay interest expenses. The recommended limit of Interest Coverage Ratio is approximately 5. Financial analysts deal with Interest Coverage Ratio due to expensive bank loans [4].

Some enterprises with low debt ratio can consider using external resources, for instance, bank loans. The main criterion is to compare difference between profitability ratio and interest rate. In the case that potential profitability ratio is greater than bank interest rate, we recommend bank loan [16].

Profitability Ratios are used to evaluate profitability of business effort. The general shape of profitability ratio compares profitability in the form of profit (EAT, EBT, EBIT, EBITDA) or CF and invested capital (equity, total assets). In general, profitability ratio should have increasing trend. The best-known profitability ratios belong Return on Sales (ROS), Return on Equity (ROE) and Return on Assets (ROA), Return on Revenues (ROR) and Return on Costs (ROC) [17].

The next group of ratios are calculated based on cash-flow. The best-known ratios based on cash flow include Current Ratio, Interest Coverage Ratio, ROE, ROA, etc.

Elementary methods include also the analysis of differential indicators that help to analyse cash flow, income analysis, expenses analysis and profit analysis [4].

Moreover, elementary methods are divided into pyramidal decomposition analysis and ex-ante analysis that focuses on prediction likelihood [5]. The ex-ante analysis consists of logit and probit model [6]. In general, model for predicting financial health divided into some groups, for instance, score models, multivariate models, logit and probit models, etc. The best-known prediction models belong Altman model (1966), Beaver model (1968), Ohlson model (1980), Springate model (1983), etc. [7]. In addition, the specific ratios are indicators of value management, such as Economic Value Added, Market Value Added, Net Present Value as a specific indicator of efficiency investments, etc. [8].

The sophisticated methods of financial analysis are divided into two groups, i. e. mathematical-statistical and non-statistical methods. The statistical methods include, for instance, regression model, discriminant analysis, etc. The aim of discriminant analysis is to determine the bankruptcy likelihood. In the past decade, many scientific publications deal with applying Artificial Intelligence in the form of Artificial Neural Networks. [9]. Financial analysts can suggest bankruptcy model based on available information from financial statements of enterprises [10]. The approach differs from conventional analytical models because ANN systems eliminate disadvantages of linearity, for instance, Altman model (1966) and Beaver model (1968) [11]. Non-statistical methods include fuzzy set by L.A. Zadeh (1965). In addition, expert systems and gnostic theory of uncertain data based on data comprising uncertainty [12].

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3. Methodology

The purpose of paper is to assess and to compare financial health of selected international Slovak and Czech airports. The sample consist of four international airports, specifically Bratislava Airport, Kosice Airport, Ostrava Airport and Prague Airport. We obtain information from financial statement from 2011 to 2017. Firstly, we assess financial health of Bratislava Airport from 2011 to 2017 based selected liquidity ratios, assets management ratios, debt ratios and profitability ratios. Secondly, we compare Bratislava Airports with Kosice Airport, Ostrava Airport and Prague Airport.

4. Results

Liquidity ratios. Figure 1 show trend of selected liquidity ratios from 2011 to 2017. Cash ratio, quick ratio and current ratio have increasing trend except for 2016. In 2017 Bratislava airport achieve recommended liquidity level. These results are excellent because in 2011 cash ratio reached at 0.02. Therefore, Bratislava Airport was unable to pay its current liabilities. The best result of cash ratio was reached at 1.04 in 2017. The main reason is decrease of current liabilities, mainly in 2012 in compared with previous year, stabilization of current receivables and to increase cash at bank accounts due to decline of current receivables. Quick ratio has positive

trend as cash ratio. Current ratio is not different from quick ratio due to low inventories volume.



Figure 1 Development of selected liquidity ratios from 2011 to 2017

Source: authors based on [18]

As shown in Figure 2, we compare liquidity ratios of Bratislava Airport, specifically, cash liquidity, quick liquidity and current liquidity with selected international airports (Kosice Airport, Ostrava Airport and Praha Airport). The highest rate of liquidity of approximately 12 have Kosice Airport. High liquidity rate is not optimal, because have negative influence on profitability ratios and potential development of international airport. Relatively high level of liquidity has Prague Airport and Ostrava Airport, too. Based on comparison we can claim that Bratislava Airport have the best level of liquidity among compared international airports in 2017.

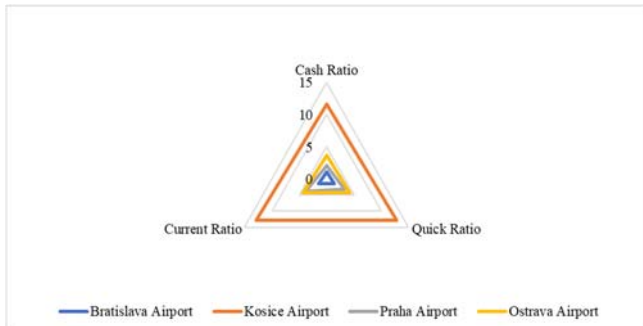


Figure 2 Comparison of liquidity ratios among selected international airports in 2017

Source: authors based on [18] [19]

Assets management ratios. These results express efficiency of transformation process. In addition, Day Sales Outstanding and Day Payables Outstanding characterize the quality of relationship among suppliers and subscribers. Day Sales Outstanding has changeable trend during analysed period. From 2015 to 2017 Day Sales Outstanding achieve 0. It caused by no current trade receivables. The least acceptable level was reached in 2011 (almost 56 days). On other hand the best level of ratio was reached in 2013 (45 days). Next year, we recorded a negative growth of more than 5 days. The reason is increase of current receivables and slight decrease in sales revenues.

Moreover, Days Payables Outstanding have positive trend from 2011 to 2014. It is confirmed by positive results of liquidity ratios. In 2015, we recorded an increase of Days Payables Outstanding about more than 8 days, i. e. negative trend.

Critical level of this ratio of more than 280 days in 2011 meant inability to pay its current liabilities. In following years, the ratio improved significantly, especially in annual comparison 2012/2011, because we recorded decline of almost 240 days. Based on comparison of Days Sales Outstanding and Days Payables Outstanding, we can claim that Bratislava Airport receive cash for services later than payment to creditors.

Next, among asset management ratios belong Asset Turnover Days, Non-Current Assets Turnover Days and Tangible Asset Turnover Days. These ratios reach high level. It is caused by capital intensity and low volume of sale revenues. Based on analysis we can claim that ratios have positive tendency from 2012 to 2017, expect for 2016. It is caused mainly decline of asset, non-current assets and tangible assets.

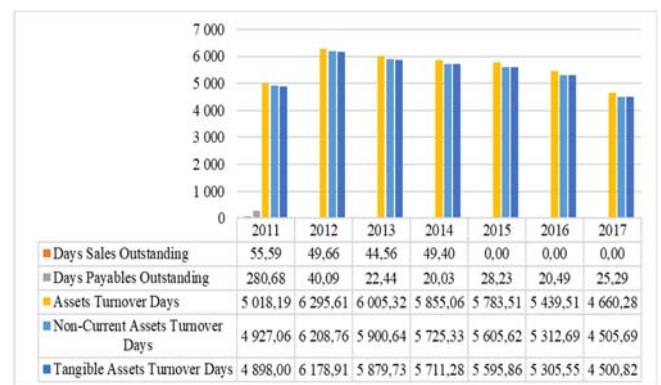


Figure 3 Development of selected asset management ratios from 2011 to 2017

Source: authors based on [18]

As shown in Figure 4, we compare Asset Management Ratios with selected international airports in 2017. Based on comparison, we can claim that Bratislava Airport haven't reached acceptable result in asset management area. It is confirmed by Asset Turnover Days and Tangible Assets Turnover Days. On the other hand, the Days Payables Outstanding reached more than 25 days, i. e. acceptable level compared to selected international airports. Prague Airport reached the best results except for Days Sales Outstanding (almost 7 days). In the case of Days Sales Outstanding, the worst level was reached by Ostrava Airport (more than 30 days). In the case of Tangible Assets Turnover Days, the best result was reached by Prague Airport (almost 134 days). The last asset management ratio is Asset Turnover Days that copy level of Tangible Assets Turnover Days.

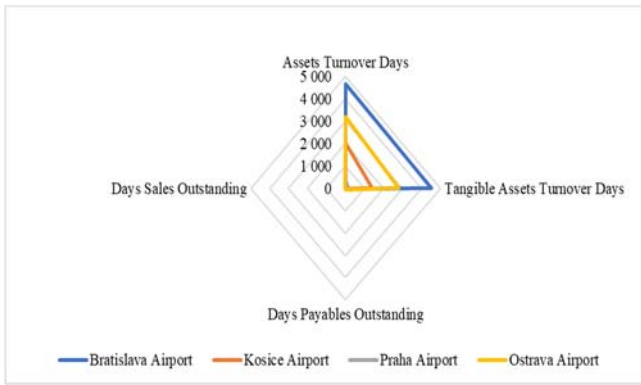


Figure 4 Comparison of selected asset management ratios among international airports in 2017

Source: authors based on [18] [19]

Debt ratios. At Bratislava Airport, total debt increased from 19 % to more than 25 % in 2012, i. e. more than 36 %. It is associated with obtaining long-term bank loan. In next period, total debt has decreased. The substantial part of the total debt includes long-term and short-term bank loans. Therefore, credit debt ratio reaches more than 16 % of total liabilities except for 2011.

Financial Leverage Ratio express ratio of assets to equity, respectively ratio of total debts to equity. We recorded rapid increase of Financial Leverage Ratio in 2012 compared to previous year due to financing airport terminal. As shown in Figure 5 shows relationship in the form of $ROE = ROA \times \text{Financial Leverage Ratio}$. Financial Leverage Ratio has negative impact on ROE because company is not able to assess external capital (bank loans).

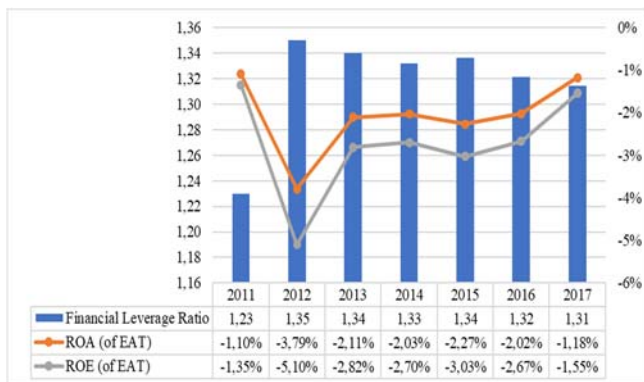


Figure 5 Impact of financial leverage ratio to profitability ratio

Source: authors based on [18]

Moreover, Interest Coverage Ratio has reached negative rate. However, in 2017 Bratislava Airport reach the best result during analysed period. The main reason is negative EBIT during all analysed period. Based on these facts, we can claim that Bratislava Airport is not able to asset capital from creditors. In addition, Bratislava Airport is not able to pay debit interest. On the other hand, we can consider as positive matter, for instance, profitability ratios are improved from 2012 to 2014. In 2014 Bratislava Airport reached the

most acceptable result during all analysed period. It is mainly caused due to improvement of EBT compared to previous period (more than 36 %). In 2015, we recorded negative trend of ROA from (-) 1.35 % to (-) 1.62 %.

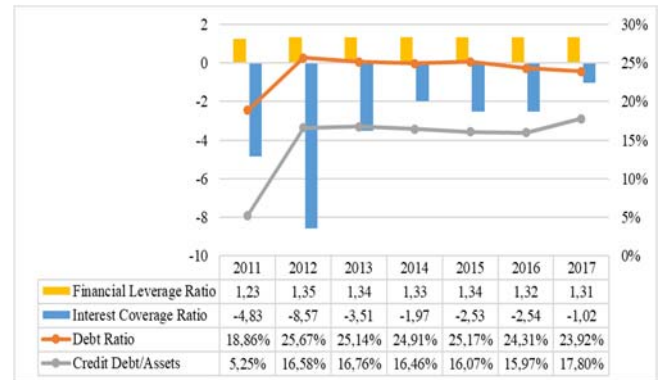


Figure 6 Development of selected leverage ratios from 2011 to 2017

Source: authors based on [18]

As shown in Figure 7, we compare debt ratios, especially Debt Ratio, Equity Ratio and Financial Leverage Ratio, among selected international airports in 2017. Bratislava Airport reached second place in total debt, i. e. approximately 24 % compared to other international airports. The lowest rate of total debt was reached by Kosice Airport (less than 5 %). Ostrava Airport has the highest level of overall debt (more than 70 %). Prague Airport have total debt of 17 %. Another ratio is financial leverage ratio. Ostrava Airport reached the highest level of Financial Leverage Ratio (almost than 350 %). It is caused by considerable share of liabilities. On the other hand, Kosice Airport reached less than 105 %, Bratislava Airport (almost 132 %) and Prague Airport (more than 122 %).

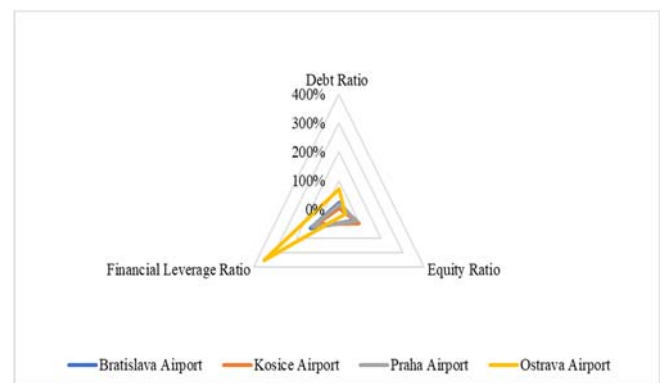


Figure 7 Comparison of selected leverage ratios among international airports in 2017

Source: authors based on [18] [19]

Profitability ratios. Based on analysis of profitability ratios, we found out that profitability ratios have reached negative level since 2011. Therefore, Bratislava Airport is not profitable. We can claim that development of profitability ratios has changeable trend. In following Figure 8, we can see

detailed development of profitability ratios during analysed period.

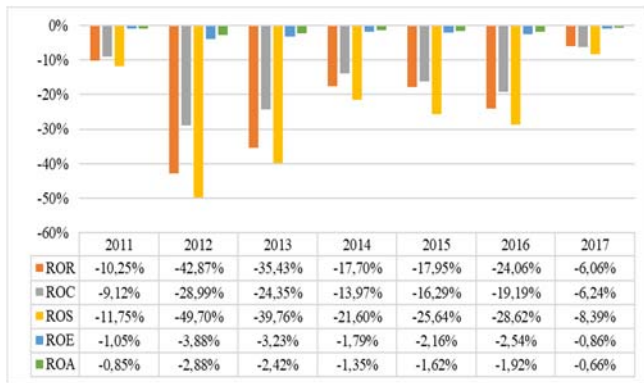


Figure 8 Development of selected profitability ratios (of EBIT) from 2011 to 2017

Source: authors based on [18]

Figure 9 shows comparison of profitability ratios (ROA, ROE and ROS) among international airports in 2017. We measure profitability based on EBITDA. The main reason is difference in tax policy and depreciation policy in the Slovak and Czech Republic. In addition, asset structure, reason is to eliminate impact of funding assets in the form capital from creditors. Bratislava Airport reached positive profitability ratios because EBITDA is positive value compared with EBIT. The highest rate in the form ROA (of EBITDA) was reached by Prague Airport (almost 46 %), on the other hand Bratislava Airport (only 3 %).

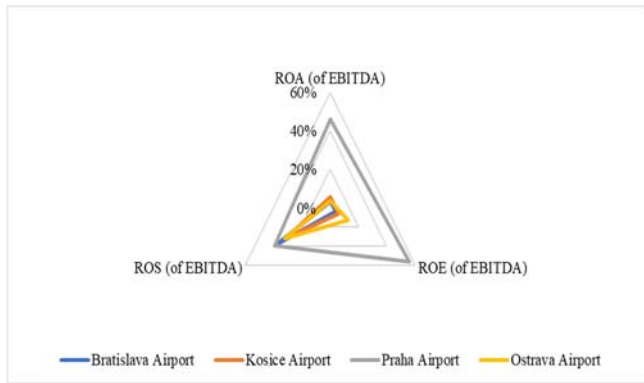


Figure 9 Comparison of selected profitability ratios (of EBITDA) among international airports in 2017

Source: authors based on [18]

Cash-flow ratios. The selected ratios include cash liquidity, ROA and ROE. During analysed period cash liquidity (of CF) have fluctuating trend. It is mainly caused with rapid decrease of current liabilities. Moreover, profitability ratios reached positive rate from 0.22 – 2.44 %. The trend is changeable due to fluctuating CF. Figure 10 shows detailed information on cash-flow ratios from 2011 to 2017.

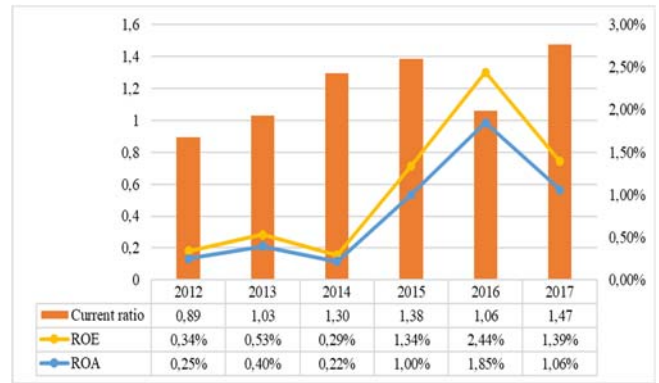


Figure 10 Development of selected cash flow ratios from 2011 to 2017

Source: authors based on [18]

5. Discussion

The aim of paper was to evaluate financial situations at Bratislava Airport. Based on methods of financial analysis we identified strengths and weaknesses of Bratislava Airport in compared with significant international airports in the Slovak and Czech Republic. We concluded that Bratislava Airport has relatively good results in current assets management. During analysed period, international airport has increased cash ratio from 0.02 to 1.04. The reason is decrease of current liabilities and gradually cash increase at bank accounts. It is obvious that reason of improvement is mainly harmonization of receivables maturity, of liabilities maturity and optimization of NWC. Moreover, Bratislava Airport achieve relatively low debt ratio, but Interest Coverage Ratio (of EBIT, of CF) indicate that debt ratio is “unhealthy” for international airport. The debt ratios have negative influence on profitability ratio. In the case of analysed enterprise doesn’t apply relationship in the form of ROE > ROA > interest expenses. Bratislava Airport is not able to assess external sources, for instance, current bank loans, long-term bank loans, etc. Company must necessarily make better use of existing airport capacity. The airport must improve the property efficiency that is confirmed by asset management ratios compared with selected international airports. The primary reason is relatively lack of sales revenues. The serious problem is that Bratislava Airport is in loss because costs are greater than sales revenues.

Future research. We can apply the results of financial analysis to evaluate the multicriterial methods - Data Envelopment Analysis (DEA) and Malquistov Productivity Index (MPI). Among authors who applied DEA belong, for instance, Lai et al. (2015), then Fragoudaki et al. (2016) who measured the effectiveness of international airports in Greece. Furthermore, Orkcuc et al. (2016) who focused on the Turkish airports [20, 21, 22].

6. Conclusion

At present, Bratislava Airport has relatively positive results in terms of passenger number. The main reason is to

extend destinations and increase of flight frequency in compare with previous period.

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Ecological Impact of Changes in Transport Organisation in Martin with Using Transport-Planning Software

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Abstract Using motor vehicles, which uses fossil fuels, is connected with emissions. The main goal of cities, towns and also of the state is to keep these emissions as low as possible. Vehicles move on a traffic network where they are forced to accelerate and decelerate due to various impacts. Junctions and traffic jams are examples of these impacts. An important task is to build transport networks and junctions where vehicles can cross the junction as quickly as possible without unnecessary delay and a significant change in speed. This can contribute to lower vehicle fuel consumption and thus lower emissions.

Keywords circular junctions, traffic survey, emissions, simulation

JEL L92

1. Introduction

Nowadays the traffic planning software is commonly used for finding the way how to change the organization of traffic at junctions or on the whole transport network. Such software can record not only traffic characteristics, but also vehicle consumption and emissions [1, 7].

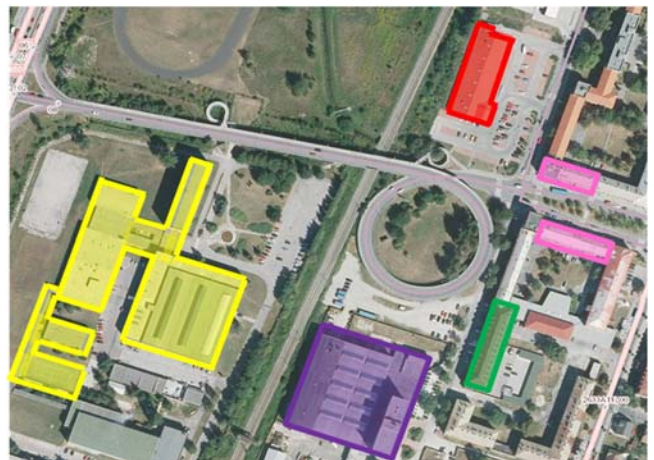
The intersected crossing is located in the centre of Martin. It is one of the important roads connecting the city centre with the first class road no. I/65 and the housing estate Podháj - Stráne. The junction is uncontrolled with four arms and has only one level. Close to this junction there is an overpass which allows overcoming the altitude difference between this junction and next intersection on the first class road no. I/65. It also allows a smooth crossing over the railway track, which connects the towns of Martin and Vrútky. This results in a safer and more fluid traffic.

Close to the junction, there are residential apartments, department store LIDL, bus stop, overpass, Secondary Combined School in Martin, Development Company in Martin, district police department, restaurant and other smaller shops.

Figure number 1 shows important civilian objects which are located near the junction. Objects are marked with following colours:

- red – department store LIDL,
- yellow – Secondary Combined School in Martin,
- purple – Development Company in Martin,
- green – district police department,
- pink – restaurant and shops.

Figure 1. Junction and important buildings marked with colours.



2. Traffic survey

The traffic survey was performed on Wednesday, October 28, 2015. The temperature was 7 °C in the morning and around 15 °C around lunchtime. At the time of the survey there was semi-cloudy sky with a wind speed of 1 - 5 m/s.

The total time of traffic survey should be 8 hours. It can be divided into two 4-hour parts. We performed survey of total duration of 10 hours. Distribution of traffic during day is uneven, so the traffic survey was divided into two 5-hour parts [5, 6]. The first part of the survey lasted from 6:00 to 11:00 am and the second in the afternoon from 13:00 to 18:00 p.m. Traffic jams at the junction are shown in the following figure.

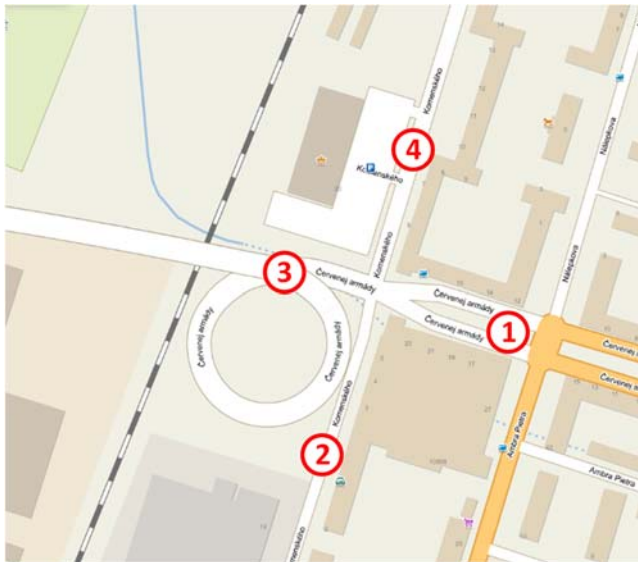


Figure 2. Location of inputs and posts



Figure 3. Location of inputs and posts

After the survey, it was possible to start its evaluation. The information from survey is necessary for capacitive calculation, transport modelling and simulation. The least loaded input was number 2, where its load over the entire survey time reached 124 vehicles. Direction of individual vehicles across the intersection area during the peak hour between 7:30 and 8:30 a.m. is shown in the following table [9, 13].

Table 1. Direction of vehicles during the peak hour

Input	Left	Straight	Right	Total
1	2	219	72	293
2	6	1	15	22
3	153	296	8	457
4	116	2	35	153
Total	277	518	130	925

The total number of vehicles that crossed the intersection from all inputs during the survey was 6,834. The entry with the highest load was input 3, which was used by 3,170 vehicles during the whole time of survey.

3. Microsimulation of current state and future proposal

The transport simulation system - Aimsun was used for creating the transport model. It is software from the Spanish company and it is commonly used for traffic planning. In this case, it was used for creating of two transport models. These were constructed on the basis of technical conditions TP102 - Capacity Calculations. Traffic models are based on mapped data and real scale. They reflect reality as accurately as possible. Ten simulations were created for both transport models and then the average was constructed. The total length of each simulation was two hours, i.e. from 7:00 to 9:00 [2, 4].

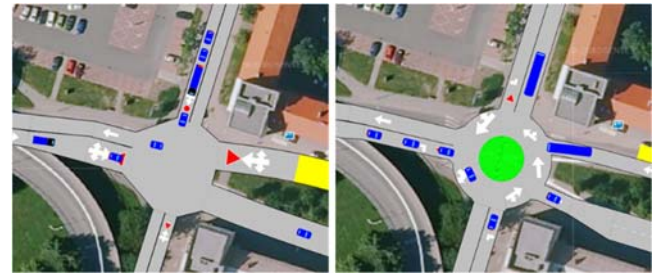


Figure 4. Creation of transport models for current and future state, source: author - processed in Aimsun software

An important recording parameter for each simulation was the residence time and its course over time. These data were then to be compared between each other [10].

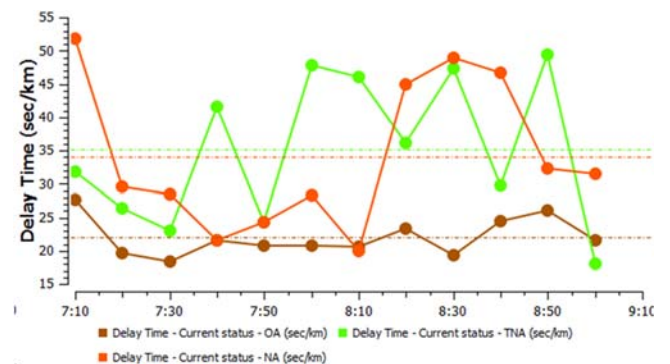


Figure 5. Delay time progress for uncontrolled junction

Progress of average delay time is shown in the figure number 6. For the each vehicle in simulation it has value of 23.15 seconds.

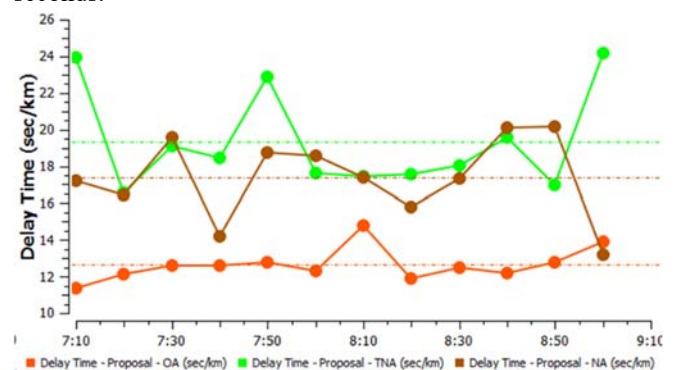


Figure 6. Delay time progress for circular junction

The average delay time for each vehicle is shown in the figure number 7. Its value is at a level of 13.17 seconds for the current state of junction. From the picture it is obvious that the circular junction achieves lower values than the uncontrolled junction. The difference between these two types of junctions is 9.98 s for each vehicle [2, 3]. Time savings are therefore at 43.11%. Additional simulated parameters are shown in the following table.

Table 2. Direction of vehicles during the peak hour

Parameter	Current status	Proposal	Units
Delay time	23.15	13.17	sec/km
Density	7.32	7.49	veh/km
Traffic flow	912.3	901.1	veh/h
Harmonic speed	25.84	29.38	km/h
Num. of all stops	1.44	0.72	#/veh/km
Stop time	21.4	3.6	sec/km
Travel time	139.35	122.55	sec/km

As can be seen from tab. 3, for most of the parameters recorded, the individual values decreased except for the incremental velocity and density that had increased. A very significant decrease was recorded at the time of the station and up to 17.80 sec/km. This difference represents a decrease of up to 83.18%. On the basis of the simulations performed, it can be stated that at the current traffic intensity, the circular junction can reduce the individual delays, not to a small extent. Simulated intensity and density are very similar. It is therefore possible to consider the given simulations as very objective [8, 13].

The reduction of the above-mentioned traffic characteristics also leads to a reduction of the individual types of emissions produced by vehicles at the junction. Traffic planning software TSS-Aimsun allowed to choose from two possible emission calculations: QUARTET, 1992 and Panis et al, 2006. The second option was the second option for calculating emissions according to the pre-set parameters from the traffic planning software. Choice of the option is in the figure number 7 [14, 15].

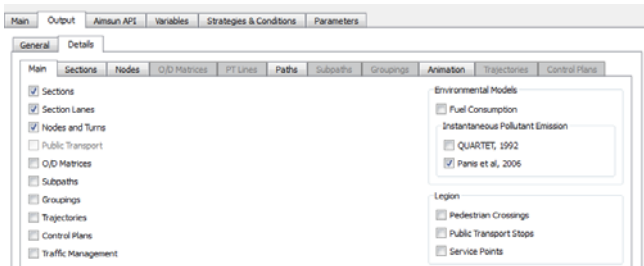


Figure 7. Choice of the emission calculation

Totally in traffic planning software 4 emission categories were recorded - IEM Emission CO₂, NO_x, PM and VOC. Recorded values are shown in the table number 4 [11, 12].

Table 3. Direction of vehicles during the peak hour

Characteristics	Current status	Proposal	Units	Decrease [%]
IEM Emission – CO ₂	600 040.7	480 014.35	g	20.00%
IEM Emission – NO _x	4 300.2	3 800.29	g	11.63%
IEM Emission – PM	168.66	124.31	g	26.30%
IEM Emission – VOC	353.87	350.33	g	1.00%

The most significant decrease of 26.30% in emissions was recorded for IEM Emission – PM. On the contrary the smallest decrease reaching 1.00% and can be considered a non-changeable value in these microsimulations. All these indicators are related to previous recorded traffic characteristics. The drop in emission values is directly related to the reduction in vehicle consumption, as there are shorter delays and a smoother passage on a simulated junction, with fewer stops.

4. Conclusions

By changing the organization of traffic at those junction in Martin, it is possible to improve some characteristics. The proposal of a new roundabout can reduce delay time, number of stops, total travel time and also stop time. The biggest decrease from all individual parameters has stop time. It decreased by 83.18% and delay time decreased by 43.11%. For these data, the segment speed was increased by 13.70% on individual sections of roads. Overall, we managed to reduce our average emissions by 14.73% on average.

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Delivery Models in Last Mile Logistics

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Abstract In logistics the key problem of last mile is how to deliver goods from distribution hub to end users in cities and built-up areas. The paper deals with an issue of last mile delivery. The main objective of the paper is to analyse possible solutions how to deliver consignments to end customers. To achieve the aim, we realized secondary research in which we identified seven basic delivery models. Some of the delivery models are traditional, but there are delivery models which are a matter of the near future. One of the most appropriate solutions how to enhance effectiveness in the process of last mile delivery is to take advantages of every identified delivery model. Results of the research also imply a comparison of delivery models.

Keywords Last Mile, Delivery Models, Drones, Droids, AGVs

JEL L87, L90, L91

1. Introduction

At present, we very often meet with the term of last mile, but a lot of people do not know what the term means. The last mile or last kilometre is a phrase widely used in the field of electronic communications, transportation, logistics, and internet industries. It can be described as a segment of delivery of products to customers located in dense areas. In supply chain management and transportation planning the term of last mile is defined as the movement of people and goods from a transportation hub to a final destination. Typical examples of the final destination are homes, retails, restaurants and other businesses.

The term of last mile was originally used in the field of electronic communications to refer to the final leg of the telecommunications networks that deliver services to customers. Then the term of last mile has been applied to supply chain management. The last mile delivery is a part of city logistics or urban logistics. There are lots of definitions of city logistics and it is very difficult to say which definition is the best. The city logistics can be described as “The process for optimizing both logistics and transport activities done by private companies in urban areas while considering the traffic environment, traffic congestion and energy consumption within the framework of a market economy” (Taniguchi et al., 1999). The city logistics also includes the transport of materials, waste collection, retail deliveries, postal and courier services. [1] [2] [3] [4]

2. Analysis of the Current State

In everyday life the last mile problem is quite a simple one. The public transport does not take people exactly where they need to go, and there are various types of transport that are not coordinated. Of course, everyone does not possess a car or other type of vehicle and it is very important to say that parking is not always available in every part of city or other place. Another problem is a poor infrastructure and lots of traffic jams.

In logistics the key problem of last mile is how to deliver goods from distribution hub to end users in cities and built-up areas. There are innumerable problems that the last mile delivery faces.

Poor Infrastructure

In developing countries there is an insufficient network of transport infrastructure what causes lots of problems associated with the delivery of goods. There is a lack of roads, highways, bridges, terminals and so on. Limited network of transport infrastructure means long journeys, inefficient routes, high costs of delivery of goods, time delays and other very serious problems. [5] [6] [7] [9]

Inefficiency

One of the main problems of last mile logistics is inefficiency. The inefficiency is caused by providing individualized shipment services to often unreliable destinations through constantly changing routes. Another issue of the inefficiency is a level of unpredictability in transit and customer availability in places of delivery. Carriers also must

count with consignment thefts and costs associated with this fact. There are whole range of issues associated with last mile logistics that can be a source of inefficiency. [5] [6] [7] [9]

Transparency

As in other areas of social life we can monitor increased demand of customers for value-added services. One of the main requirements is transparency of the product. In general, people have always had the desire to know, anticipate and to have an overview. Due to the requirements of customers postal and logistics companies have had introduced various new products into their product portfolios. One of the most important services is the possibility of tracking a consignment. Nowadays, Track & Trace services provide information about details of the delivery status and the last performed operation in the shipment process.

In the modern on-demand era, tracking services do not satisfy needs of customers because they want to have a real-time visibility of the consignment in every minute of the delivery. Customers want to know where the courier is and when he will arrive. [5] [6] [7] [9]

Various Types of Goods

Type of goods can be a big challenge of the last mile delivery. There are two category of consignments: generic and specific. Specific consignments require special arrangements because they may cause damage of the environment, for example toxic, fragile, flammable, perishable or large sized consignments. Due to the fact there are special conditions for vehicles (temperature requirements, special requirements regarding dangerous consignments, side loader, tailgate lift, etc.). The last mile delivery of specific goods requires very complex planning that costs lots of time, money and knowledge. [7] [8] [9]

3. Methodology

The primary aim of the paper is the identification of last mile delivery models and the possible solutions how to efficiently deliver shipment to end customers. Other objective of the article is to inform readers about the concept of city logistics and the last mile delivery problems. To achieve the goals, we realized secondary research in which we used various scientific methods. Among basic methods of the secondary research belong method of collecting and processing data, analysis and synthesis of knowledge, methods using the principles of logic and logical thinking and the comparison method. The main sources of the secondary research are information materials of foreign authors dealing with the issue of the last mile delivery.

4. Results

There are various solutions of the last mile delivery problems on the market. It is very difficult to propose an optimal solution for all regions. All solutions of the last mile delivery

should be designed with regard to the specifics of the particular region.

At present, we can find various delivery models. Some of the operational models are traditional, but there are delivery models which are a matter of the near future. There are identified seven operational models.

4.1. Traditional Models of Last Mile Delivery

Now we know three basic traditional models of last mile delivery. Every of the traditional models has some advantages and disadvantages.

Today's Model

In today's model the delivery is provided by authorized person of the logistics or postal operator. By the term "authorized person" we mean a courier or postman. The authorized person picks up the parcels at a consolidation point and delivers them to the addresses. In today's model, there is very popular hub and spoke concept. The hub and spoke network is based on the existence of one logistics centre (hub) from which a certain territory is served in a spoke way. Typical delivery vehicles are large vans. [10] [11] [15]

Model of Bike Couriers

In model of bike couriers, delivery is provided by employees of the postal or logistics company. These employees deliver small number of parcels by bikes. Bike couriers are used in big cities in point-to-point delivery. Typical examples of consignments are B2B documents, food or pharmaceutical products. [10] [11] [15]

Model of Crowdsourcing

Crowdsourcing is a network where any members who have signed up as drivers can choose to perform a specific delivery order. The main benefit of the model of crowdsourcing is flexibility in supply. [10] [11] [15]

4.2. Future Models of Last Mile Delivery

In this chapter, there are identified four modern last mile delivery models that can improve last mile delivery process. Each of the models brings certain benefits and threats.

Delivery by Drones

Drones are autonomous aircrafts or unmanned aerial vehicles (UAVs) that can carry parcels to their destinations along the most direct route. The maximum weight of transported parcels is up to 15 kg. Primary condition of the delivery by drones is supervising.



Figure 1. Drone Delivery

(Source: Jamie Condliffe. Delivery Option: Drone. Arrival Estimate: 2020. 2016. Online Available: <https://www.technologyreview.com/s/602527/delivery-option-drone-arrival-estimate-2020/>)

There are lots of studies indicating that cargo drones can play a significant role in last mile delivery. Many large companies like Amazon, Google or Airbus have launched research programs for drones that develop very quickly. In some rough environments like Africa or Canada, cargo drones transport medication to long-distance areas.

Cargo drones can help to resolve problems that densely populated regions face nowadays. Among the most important issues belongs inefficiency of delivery in the last mile, pollution of air or overcrowding of roads by cars.

Of course, we have to say that there are lots of obstacles in implementation of drones in cities. Among the most significant barriers belong legislative – laws and regulations. It is very necessary to exact rules how the drone transport should work. Other very relevant obstacle is cybercrime because various connected devices can be hacked and subsequently misused. It follows that safety and security should be the number one in designing drones. There are far more issues that must be solved in the case of the implementation of drones in the last mile logistics. [10] [11] [12] [15]

Delivery by Autonomous Ground Vehicles (AGVs) with Lockers

Autonomous ground vehicles are vehicles that do not need an on-board human presence. These vehicles deliver parcels without any human intervention. Customers get notifications about the exact arrival time. AGVs contain lockers where customers can pick up the parcels. These autonomous ground vehicles are called mobile parcel lockers.

The operation of AGVs needs to be supervised. One supervisor could manage route eight to ten autonomous ground vehicles. Benefits of AGVs are flexibility, safety, scheduling, exact tracking or accountability. [10] [11] [13] [15]



Figure 2. Autonomous Ground Vehicles with Lockers

(Source: Disha Amin. AUTONOMOUS GROUND VEHICLES (AGVS) WITH LOCKERS. 2018. Online Available: <https://logisticsmgpsupv.wordpress.com/2018/05/14/autonomous-ground-vehicles-agvs-with-lockers/>)

Delivery by Semiautonomous Ground Vehicles

In model of semiautonomous ground vehicles, there is still required a delivery person, but he could theoretically use the driving time more efficiently to take care of sorting or smaller administrative tasks e.g., scanning or announcing arrival while the vehicle does the driving. There are lots of advantages and disadvantages in the delivery by semiautonomous ground vehicles. Among minuses of this delivery belongs higher investment cost, because AGVs are more expensive than classic delivery cars or vans. Sometimes, the movement of the delivery person can be limited because of obstacles on the way. [10] [11] [13] [15]

Delivery by Droids

Droid is a small robotic machine or autonomous vehicle which comes in various shapes or sizes. In logistics, droids are bigger than a regular parcel.



Figure 3. Droid: Self-driving Robot

(Source: Tiny self-driving robots have started delivering food on-demand in Silicon Valley — take a look. Melia Robinson. 2018. Online Available: <https://logisticsmgpsupv.wordpress.com/2018/05/14/autonomous-ground-vehicles-agvs-with-lockers/>)

Delivery by droids is provided to the doorstep. These vehicles are equipped with GPS and camera for navigation. To ensure safety in delivery, droids are opened with a unique code known only to the customer. Droids also use sensors to avoid obstacle on the road. The speed of the droid is 5 to 12

kilometres per hour, but the speed depends on the type of the droid. Like drones or AGVs, droids have to be monitored by human operators. One operator or supervisor would manage 50 to 100 of droids due to the small size and low speed. Delivery by droids is very ecological because droids do not pollute air like vehicles and they work with low noise. The energy consumption of the droid is equal to light bulb, so we can say that this solution of the delivery is very economic. [10] [11] [14] [15]

4.3. Comparison of Last Mile Delivery Models

Each of the models examined comes with benefits and limitations. In the table 1. there are summarized the key advantages and disadvantages of each model and also the stage of use.

Table 1. Comparison of last mile delivery model

<i>Model</i>	<i>Benefits</i>	<i>Limitations</i>	<i>Stage of use</i>
Today's	Personal contact between business and customers, acceptance by the public, very low investment cost, providing consultations to customers by delivery person	Noise, high-cost solution, pollution of air, poor or overcrowded road infrastructure, fatigue of driver	Utilization in every country
Bike Couriers	Ecological delivery, low-cost solution, noise	Possibility to deliver only small consignments for short distances, fatigue of driver	Utilization in big cities
Crowdsourcing	Flexibility in supply, lower costs of delivery	Thefts, delivery person is not authorized, pollution of air, noise, fatigue of driver	Utilization in developed countries
Drones	Fast and flexible delivery, environmentally friendly solution, possibility to reach remote or hard-to-reach locations more cheaply, solution of poor infrastructure problem	Legislative, Supervising – they must be monitored by human operators, maximum weight of parcels is 15 kg, cybercrime - safety and privacy issues, delivery distance limitations, noise, higher investment cost	Pilot version of use
Autonomous Ground Vehicles	Fast and flexible delivery (scheduling, exact tracking or accountability), low-cost solutions, environmentally friendly, cost-efficient to reach remote locations,	Supervising – AGVs must be monitored by human operators, cybercrime - safety and privacy issues, higher investment cost	Experimental stage of use
Semiautonomous Ground Vehicles	Possibility to use the driving time more efficiently	Cybercrime - safety and privacy issues, higher investment cost, sometimes obstacles in movement of the delivery person	Utilization in some areas
Droids	Low-cost solutions, environmentally friendly, low-noise device	Supervising – they must be monitored by human operators, low speed, possibility to deliver only small consignments, cybercrime - safety and privacy issues, theft issues	Pilot version of use

5. Conclusions

The development of modern technologies and digitization significantly changes the logistics and postal services. In last

mile delivery postal or logistics operators can apply various achievements of modern technologies. Due to development of modern technologies we can see lots of new delivery models. The main objective of the new delivery models is to reduce carbon footprint. All the modern last mile delivery models are environmentally friendly and their impact on the environment is minimal. One of the most prospective models is drone delivery that can resolve current problems of last mile like poor infrastructure, overcrowding of roads or inefficiency. However, we have to state that modern delivery models do not provide an opportunity of personal contact between businesses and customers. A very serious risk of modern delivery models is cybercrime and potential issues with safety and privacy. Finally, we have to conclude that every delivery model has some advantages and disadvantages. Each delivery is different and it is very important to select optimal delivery model for a particular type of consignment.

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Research on Relationship Between Road Freight Transport and Infrastructure in European Countries

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Abstract The article deals with research of relationship between the performance of road and freight transport and transport infrastructure (motorways) in EU countries. The main goal is to find out how transport infrastructure has a relationship and influence on the development of transport performance. The relationship between transport performance and transport infrastructure has been examined by correlation and regression analysis. Research has shown that the strength of these relationships is different for states. There is a strong direct and indirect dependence between transport infrastructure and transport performance.

Keywords road freight transport performance, motorway, road infrastructure,

JEL R40

1. Introduction

Transport is an indispensable basis for the support of almost all economy's sectors. It is necessary to support and safeguard social and economic processes connected to transport [1]. Transport services are important for economic growth and society development [2]. It has a wider impact on microeconomic factors of productivity such as the labor market, domestic and international trade, investment and innovation. Transport infrastructure is an integral part of a transport system of any city or state. In connection to the development of societies and intensification of international relations due to the globalization processes, the importance of transport as a factor for economic and social development has enhanced [3]. Infrastructure development is one of the visible signs of technological progress. Many studies state that transport infrastructure is one of the most important factors of the regions' development, which enables the creation of new businesses or supports contacts with other regions. Many different factors affect the economic growth, but they are all directly or indirectly related to infrastructure development [4, 5]. As example it may be given that the construction of motorways increases regional accessibility and enhances human activities along the transportation routes. Well-developed transport infrastructure can be seen as a precondition for regional economic integration. For instance, transport of agricultural products can develop faster and faster in farming areas. Transport accessibility is determined by the way the area

is developed making it possible to move in various conditions [6]. What is the correlation between the development of the transport infrastructure and the growth of the freight transport performance in road and rail transport? Growth in transport performance is related to the growth of gross domestic product [7, 8].

2. Transport Infrastructure and Its Importance

One of the most important presumption and factors of the social and economic development of the states and their regions is road infrastructure. This is also true in the Slovak Republic as road transport is the most widespread transport sector [9].

The development of transport infrastructure has been regarded long as the main instrument for promotion of economic development. Several studies point to a close link between investment in infrastructure and the economic development of a region [10, 11, 12].

Tuhin Subhra Maparu and Tarak Nath Mazumder showed existence of long-run relationship between transport infrastructure and economic development and that the direction of causality is from economic development to transport infrastructure in most of the cases thus drawing support in favour of Wagner's law [13].

It was not possible to obtain complete data on all EU countries. In their next review, only those states that had the data

for the given period for transport performance and infrastructure at the same time were selected. For road transport 25 countries of Europe could be analysed (Tab.1).

Table 1. Length of motorway infrastructure in European countries (km)

	2010	2011	2012	2013	2014	2015	2016
Bulgaria	437	458	541	605	610	734	740
Czech Republic	734	745	751	776	776	776	1 223
Germany	12 819	12 845	12 879	12 917	12 949	12 993	12 996
Estonia	115	115	124	140	141	147	145
Ireland	900	900	900	897	897	916	916
Spain	14 262	14 531	14 701	14 981	15 049	15 336	15 444
France	11 392	11 413	11 413	11 552	11 560	11 599	11 612
Croatia	1 244	1 254	1 254	1 289	1 290	1 310	1 310
Italy	6 668	6 668	6 726	6 751	6 844	6 943	6 943
Cyprus	257	257	257	257	257	272	272
Lithuania	309	309	309	309	309	309	314
Luxembourg	152	152	152	152	152	161	161
Hungary	1 477	1 516	1 515	1 767	1 782	1 884	1 924
Netherlands	2 646	2 651	2 658	2 666	2 678	2 730	2 756
Austria	1 719	1 719	1 719	1 719	1 719	1 719	1 719
Poland	857	1 070	1 365	1 482	1 556	1 559	1 640
Portugal	2 737	2 737	2 988	3 035	3 065	3 065	3 065
Romania	332	350	550	644	683	747	747
Slovenia	768	768	769	770	770	773	773
Slovakia	416	419	419	420	420	463	463
Finland	779	790	780	810	881	881	890
Sweden	1 971	1 957	2 004	2 044	2 088	2 119	2 118
United Kingdom	3 672	3 686	3 733	3 756	3 760	3 768	3 764
Norway	381	393	392	392	392	392	392
Switzerland	1 406	1 415	1 419	1 419	1 429	1 440	1 447

The development and length of road infrastructure is different for individual EU countries. It is possible to assert that almost all states have been recorded with the growth of the infrastructure. For some countries, growth was weak or not. The most significant growth was in the Czech Republic. The drop is recorded only for the United Kingdom and Estonia. However, this decrease is negligible.

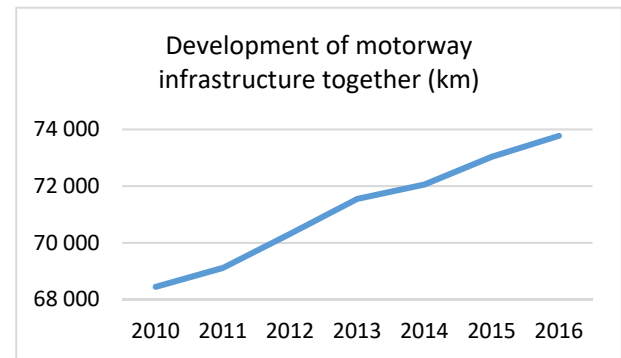


Figure 1. Development of motorway infrastructure for selected European countries together

In graph (Fig. 1) is possible to see that the length of infrastructure for these states has grown together gradually. This would also mean the growth of transport performance.

In tab. 1 is the data on the length of the motorway network in the EU.

3. Development of Transport Performance in European Countries

The development of transport performance in road freight was not uniform. The most significant growth was in Poland. It can be noticed that the western EU countries have experienced a decline (eg Spain, France, Italy). On the other hand, the countries of the eastern EU recorded growth (Romania, Bulgaria, Hungary). The most noticeable growth was recorded by Poland, where despite the crisis the transport performance grew.

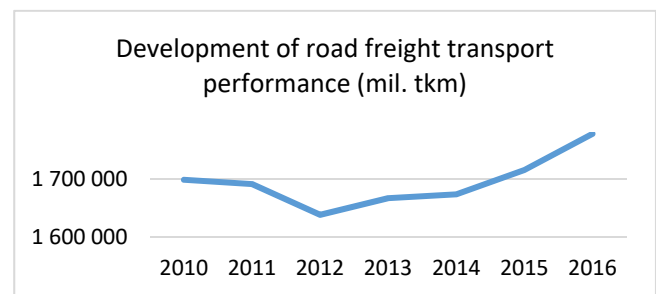


Figure 2. Development of road freight transport performance for selected European countries together (mil. tkm)

When we compare the development of transport performance and road transport infrastructure, it is possible to estimate that they have a similar pattern since 2012. It is also important to examine the transport performance relationships with the length of the infrastructure for each country. The following chapter deals with this relationship.

Table 2 show the statistical data on transport performance in case of freight road transport. Data are expressed individually for selected European countries. Outputs are expressed in millions of tonne-kilometers. The tonne-kilometer ratio is a more reliable indicator because the performance measured only in the tonne of transferred tonnage does not take into

account the number of kilometers driven by the transport infrastructure with use of loaded vehicle. The expression in tonne-kilometers (transport performance) expresses the multiple of the weights of things and the distance traveled with these things. For this reason, we will discuss only the transport performance expressed in tkm.

Table 2. Development of road freight transport performance (mil. tkm)

	2010	2011	2012	2013	2014	2015	2016
Bulgaria	19433	21214	24372	27097	27854	32297	35409
Czech Rep.	51832	54830	51228	54893	54092	58715	50315
Germany	313104	323833	307009	305744	310142	314816	315774
Estonia	5614	5912	5791	5986	6310	6263	6716
Ireland	10939	10108	9976	9215	9751	9900	11616
Spain	210068	206843	199209	192597	195767	209390	216997
France	182193	185685	172445	171472	165225	153580	155843
Croatia	8780	8926	8649	9133	9381	10439	11337
Italy	175775	142843	124015	127241	117813	116820	112637
Cyprus	1087	941	896	634	538	563	703
Lithuania	19398	21512	23449	26338	28067	26485	30974
Luxembourg	8694	8835	7950	8606	9599	8850	9324
Hungary	33721	34529	33736	35818	37517	38353	40002
Netherlands	76836	75543	70085	72081	72338	68900	67779
Austria	28659	28542	26089	24213	25260	25458	26138
Poland	202308	207651	222332	247594	250931	260713	290749
Portugal	35368	36453	32935	36555	34863	31835	34877
Romania	25889	26349	29662	34026	35136	39023	48176
Slovenia	15931	16439	15888	15905	16273	17909	18707
Slovakia	27575	29179	29693	30147	31358	33540	36139
Finland	29532	26863	25460	24429	23401	24488	26846
Sweden	36268	36932	33481	33529	41964	41502	42673
United K.	146685	148733	150949	139703	135393	150101	155042
Norway	19751	19188	20171	21317	21594	23136	20910
Switzerland	13237	13567	12966	12817	13067	12441	12134

4. Research on Relationship Between Road Freight Transport and Infrastructure in European Countries

In the context of research on the relationship between freight transport performance and transport infrastructure in EU countries, methods of regression and correlation were used:

- correlation analysis,
- regression analysis.

The variables in the correlation and regression analyses were chosen as follows:

- dependent (explained) variable *Y* as transport performance,
- independent (explanatory) variable *X* as the length of the infrastructure.

After selecting the variables, the correlation coefficient was calculated:

$$r = \frac{cov(x,y)}{s_x*s_y} = \frac{\bar{xy}-\bar{x}\bar{y}}{\sqrt{\bar{x}^2-\bar{x}^2}\sqrt{\bar{y}^2-\bar{y}^2}} \quad (1)$$

To determine the correlation strength, the following criteria were identified:

- weak dependence, if $0 < |r| < 0.3$,
- middle dependence, if $0.3 \leq |r| < 0.8$,
- strong dependence, if $0.8 \leq |r| < 1$.

The dependency we have searched for was modeled by a linear function in the form (line equation):

$$y = a+bx, \quad (2)$$

where we do not know the coefficients of the line *a* (locating constant), *b* we are looking for the variables *X* and *Y*.

The following tables (Tab. 3) show the results of analyse. The significance level was selected at the level $\alpha = 0,01$.

Table 3. Analysis results

	Country	Correlation coefficient	Determination coefficient	Coefficient a	Coefficient b	P-value a	P-value X	Significance F
strong direct dependence	Austria	0.9983	0.9966	0	15.321	X	0.000	0.000
	Bulgaria	0.9881	0.9991	0	45.549	X	0.000	0.000
	Hungary	0.9568	0.6738	15 163.4	12.435	0.003	0.001	0.001
	Slovakia	0.9040	0.9977	0	72.171	X	0.000	0.000
	Poland	0.9019	0.8135	107 390.5	97.654	0.014	0.005	0.005
	Slovenia	0.8737	0.7633	-341 673.3	465.362	0.012	0.010	0.010
	Romania	0.8709	0.9814	0	57.327	X	0.000	0.000
	Croatia	0.8546	0.7304	-29 788.0	30.741	0.039	0.014	0.014
	Estonia	0.8127	0.6605	3 232.5	21.537	0.017	0.017	0.026
middle direct dependence	Sweden	0.7343	0.9942	0	18.647	X	0.000	0.000
	Lithuania	0.6432	0.9801	0	81.324	X	0.000	0.000
	Ireland	0.5375	0.9953	0	11.306	X	0.000	0.000
	Luxembourg	0.3231	0.9972	0	57.157	X	0.000	0.000
Norway	Norway	0.3161	0.9969	0	53.431	X	0.000	0.000
weak direct dependence	Spain	0.1465	0.9980	0	13.711	X	0.000	0.000
weak indirect dependence	United K.	-0.1089	0.9980	0	39.270	X	0.000	0.000
	Germany	-0.1164	0.9996	0	24.230	X	0.000	0.000
middle indirect dependence	Cyprus	-0.4322	0.9334	0	2.921	X	0.000	0.000
	Portugal	-0.4483	0.9936	0	11.700	X	0.000	0.000
	Czech Rep.	-0.4664	0.9516	0	62.312	X	0.000	0.000
	Finland	-0.4937	0.9871	0	30.984	X	0.000	0.000
	Italy	-0.7616	0.5800	1 089 217.1	-141.080	0.031	0.047	0.047
strong indirect dependence	Netherlands	-0.8208	0.9966	245 056.2	-64.511	0.006	0.024	0.024
	Switzerland	-0.8605	0.7405	53 714.2	-28.649	0.004	0.013	0.013
	France	-0.8960	0.8028	1 481 243.4	-114.007	0.004	0.006	0.006

Individual countries are ranked according to the correlation coefficients in Table X. From the strongest direct dependence to the strongest indirect dependence. If the locating constant was insignificant, it was eliminated from the regression model.

Results of the analyses (table X) show that the interconnection of infrastructure with the development of road freight transport performance is different in the countries observed. Based on our established criteria for determining the strength of the correlation, strong direct dependence was found in Austria, Bulgaria, Hungary, Slovakia, Poland, Slovenia, Romania, Croatia, Estonia.

Average direct dependence was observed with Sweden, Lithuania, Ireland, Luxembourg, Norway. Spain has a weak direct dependence.

We see weak indirect dependence on the United Kingdom and Germany. Intermediate strong dependence is reached by Cyprus, Portugal, Czech Republic, Finland and Italy.

Strong indirect dependence is observed in the states of Netherland, Switzerland and France.

The significance level of the whole model (Significance F), coefficients a (P-value a) and b (P-value x) was less than 0.05 for each examined relationship. The determinative factor in 17 countries was higher than 0.9. The lowest determinant was in Italy (0.58).

The year-to-year correlation between transmission capacity and infrastructure length for selected countries were calculated as the next step.

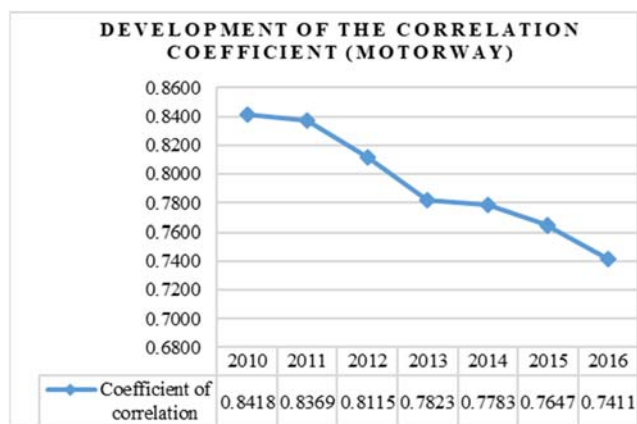


Figure 3. Development of correlation coefficient for road transport and transport performance

On graph (Fig. 3) can be seen that the strength of the relationship for all countries surveyed for road freight is gradually decreasing. In 2010, the correlation coefficient between transport performance and the length of the infrastructure had a strong direct dependence value (0.8418). However, in 2016, the correlation coefficient reached only moderate direct dependence (0.7411). From this it can be deduced that the dependence between the freight transport performance and the road freight infrastructure is weak every year.

5. Conclusions

The contribution showed that the growth of road infrastructure lengths (motorways) also increases transport performance, but the correlation decreases with only moderate direct dependence (0.7411). This means that transport performance will increase despite the fact that the length of motorways does not increase. It should be noted that, especially in Western European countries, the length of motorways does not increase significantly but increases their permeability by increasing the number of lanes, introducing intelligent transport systems, etc. In the Central and Eastern European countries, large volumes of transport performance are mainly

carried out on Class I roads. Also, the increase in transport performance in road freight transport is strongly linked to the growth of gross domestic product [X]. The pace of construction in some countries unfortunately does not copy GDP growth and revenue into the state budget. The shift of construction dates and the completion of contiguous sections of motorways may, in particular, in international road freight transport, influence the direction of transit traffic if other corridors exist.

Especially in road freight transport, it would be interesting to examine the dependence between the length of the motorways and the transport performance by individual states, respectively. exploration to be extended to lower category journeys where road haulage can be carried out.

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