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Content

Management of integrated passenger transport system and its role in tourism development

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Abstract

This contribution aims to prepare theoretical background for a PhD thesis titled Integrated passenger transport management systems in the development of tourism. The aim of the paper is to explore the current knowledge in the field of the integrated passenger transport system (IPTS) in the context of the tourism development, identify the unanswered questions that require further research and assess some elements of the IPTS development potential. The areas of economic theory – consumer theory in transport, the management of the integrated transport system, and financial management, more specifically, investments in the integrated transport system – were chosen for elaborating the theoretical starting points.

Integrated management of passenger transport in cooperation with all carriers and at least in a group of several municipalities, is a discussed intention of a number of municipalities. The integrated system has the potential to simplify transportation for passengers and also increase the volume of passenger transportation. High-quality transport service is one of the success factors of a tourism destination. Road passenger transport continues to expand as it offers fast transport at an affordable price. For this reason, the integrated transport system is also a frequently addressed topic, but it is not much explored in relation to tourism.

An effective integrated passenger transport management system can contribute to the development of tourism in a given area and to the subsequent development of the area. In the South Bohemian Region, the integrated transport system is not fully functional, so there is a space for its innovation, and it provides research possibilities. This topic also shows publication and theoretical-research potential.

Keywords: Integrated transport system (ITS), Consumer theory in transport, ITS management, Investments in ITS, Tourism development

JEL Classification: L91, O18, R40, R41

1 Introduction

Transport and tourism are closely related, as transport is one of the basic elements of mobility that are important for participation in tourism. Every year, transport enables millions of people around the world to participate in tourism, but the relationship directly between transport and tourism is difficult to quantify.

Basic background for investigating the topic consists of the Consumer theory in transport; Management of an integrated transport system, and Investments in the integrated transport system. Passengers' behaviour and the demand for transport from passengers are important for creating the transport offer. Passengers' decisions depend not only on the available offer but also on the chosen preferences, utility, and other factors. Transport users can be stimulated or motivated to use public transport and, based on increasing demand, subsequently improve and adapt the offer.

The management of individual processes can serve the transport coordinator as the basis for applying an integrated transport system. All activities and processes must be managed and coordinated to be performed effectively. In every company, this area of management is essential for its proper operation. For this reason, it is also necessary to focus on business process management in public transport, especially when integrating and cooperating with multiple transport entities managed by a transport coordinator. In this area, we can talk about the business processes of the transport coordinator as well as individual interested carriers and entities. In order for the integration to be effective and for all interested parties to cooperate properly, it is necessary to have established internal and external processes that follow each other. In order for these processes to be functional, their information and knowledge support, which can be secured using expert systems, is also important. There are also certain specifics that must be taken into account.

To make the transport smooth and comfortable for passengers, it is necessary to invest in its various elements, including infrastructure, vehicles, information and telematics systems, equipment, security, and stops. The chapter includes the financing of an investment project, the evaluation of the effectiveness of investments and the specifics of investments in transport - their financing and the impact of investments in mass transport.

2 Objectives and methodology

The aim of the paper is to explore the current knowledge in the field of the integrated passenger transport system (IPTS) in the context of the tourism development, identify the unanswered questions that require further research and assess some elements of the IPTS development potential. The paper will further study the opinions of experts on the importance of public transport in tourism compared to the potential of shared individual transport. First, it is necessary to identify research gaps that will lead to research questions.

The theoretical background is mainly based on the high-quality literature research. The tools for preparing a review of the current knowledge is based on the available general guidelines citing particular tools (e.g. Prill, Ayeni, & Becker, 2021 or Heyn, Meeks, & Pruchno, 2019).The contribution summarizes the current scientific findings on the investigated issue, which is focused on an integrated transport system. It presents the original ideas and approaches of many authors who bring a new perspective to the examined issue.

First, a preliminary assessment of the scope of the literature was conducted. Key concepts, types of evidence and research gaps related to the defined area were mapped through a systematic search and synthesis of existing knowledge. Although the search strategy is flexible, the review was conducted comprehensively and unbiased. Synthetic methods are well organized and include summaries and narratives. The aim was to cover the current literature. Based on this search, it is possible to identify gaps in the research literature and thus commission further reviews or primary research. The search methodology was adopted as follows:

- The search strategy is determined by the scope limitation.
- A formal literature appraisal is not included.
- Recommendations for future research are included.

3 Theoretical background

3.1 Integrated traffic management system

3.1.1 Definition of terms

The need to relocate (people and things) has existed since the beginning of humanity, and today, it is a daily necessity. Because people require more and more options to get to their

chosen place, it is necessary to improve, facilitate and mainly speed up transport. Speed is one of the transport priorities for passengers, except for tourists and passengers who enjoy the journey itself (Button, 2010).

Basic terms related to the integrated passenger transport management system in tourism development are generally understood and defined by experts in the same or similar way. The essential element is **transport** (see e.g., Kolář, 2019), which is the intentional movement of a means of transport (i.e., a technical means intended for transport) along transport routes (i.e., spaces designated or defined for transport). **Conveyance** is then the result of transport, i.e., an activity that consists of moving people, things and animals. The transport can be carried out for one's own needs - to satisfy one's own transport needs (no obligation relationship arises), or for the needs of others - a legal relationship (transportation contract) is created between the person requesting the transport and the transport operator. Two other frequently confused names are related to these concepts, which are also explained by Kolář (2019). It is the **carrier** - i.e., the transport operator (owns the means of transport and offers transport services) and the **conveyor** - someone who orders the transport (the collective name for the sender and recipient). The carrier and conveyor enter into a contract of carriage, and a legal relationship arises between them. According to the Act No. 111/1994 Coll., on road transport, transport can be **international** (the point of origin and destination is located on the territory of two different states) or **domestic** (on the territory of one state). The notion of **public transport** means a purposeful relocation of people in the assumed temporal and spatial contexts – within the city. An important term defined by, for example, Křivda, Richtář and Olivková (2007) is an **integrated transport system** (ITS) that unifies the offer of mass transport into a single unit. It connects all types of urban and regional transport – transport is provided by multiple carriers and various means of transport (bus, trolleybus, metro, train, tram, boat, cable car, etc.). Timetables (following connections), tariffs, and information must be coordinated to make it easier for passengers to travel around the area. **Tourism** is the sum of activities and temporary stays of travellers outside their residences together with the sum of services and products provided to these travellers (Pásková & Zelenka, 2012). Transport is then an important element for tourists in the destination and in transportation to the given area.

Specifics of transport as offered and demanded services

The specificity of transport is the fact that it is a provided service, which can be public or private. Public mass transport (in the city, it is public transport and taxi service) is a public service, while private car transport or car rental is a private service. A newer service is shared

transport, e.g., carsharing and bikesharing (shared cars and bikes), which belong to public transport. In the case of ITS, there are both variants – public and private service. Murphy (2016) states that new individual passenger transport services as well as longer established service models, such as taxis or rental companies, can supplement the public transport offer.

Paul Samuelson is considered the founder of the theory of public goods. In his work in the 1950s, Samuelson (1954) defined the term public good. Fialová (2007) define a public good in such a way that it serves the benefit of the whole society, no one can be excluded from its use, and its price is lower than the market price (it can even be zero) since the costs of the good are covered by another entity, usually from the public budget. As Holman (2011) mentions, public mass transit is part of the non-profit sector, and because it is provided by the public sector, it can be called a public good, although it does not correspond to a non-rivalrous good. A good is nonrival if all consumers can consume it together and no consumer is excluded from consumption. In the case of mass transport, this only applies until the capacity of the means of transport is filled, after which other consumers can no longer use it. This estate must be financed from the public budget, unlike private estates. According to these definitions, it can be said that a public good could be a public road, which would apply to most roads, but, for example, the use of a motorway may be excluded for users who do not pay tolls.

Transport systems fulfil the function of blood circulation in all cities, regions, states, and the entire world. Transport is an integral part of everyday life, and its origin is caused by the demand for transport (i.e., the movement of people or goods) due to the different places of fulfilment of various human needs and the mismatch between the place of extraction and the subsequent consumption of raw materials. It can be the need to get to schools, jobs, etc., but also the import and export of products (Říha & Honců, 2012).

Button (2010) states that people need to move constantly, and one of the priorities is the speed of transportation, so they choose the mode of transportation accordingly. As Žemlička and Mynářík (2008) state, since the invention of the steam engine by James Watt in 1769, motor vehicles have developed through steam vehicles and electric cars to their present form. In 1898, many car factories were established (e.g., Rolls-Royce in England, Peugeot and Renault in France, Mercedes in Germany, and Fiat or Bugatti in Italy. According to Jelen (1974), the invention of tires was a major milestone in the development of road motor vehicles. As Schley (2001) states, the idea to create an ITS comes from Germany, Austria and Switzerland. The first ITS in the world was the Hamburger Verkehrsverbund, which was founded in 1965 in Hamburg. In 1984, an innovative fare system was introduced in Basel, Switzerland. Puchler

and Kurth (1995) mention that, thanks to the introduction of integrated transport systems, some of the passengers who traveled by car returned to using mass transport.

To facilitate the use of multiple means of transport to meet city transport needs, aggregate offers are proposed to make public transport more attractive at the expense of individual private cars. This type of offer is referred to as Mobility as a Service (MaaS) (Burrows, 2016; Kerttu, Smidfelt Rosqvist, & Wendle, 2017). According to Smith, Sochor and Karlsson (2017), public and private providers may have conflicting goals. A private MaaS operator tries to sell as many and as expensive rides as possible to maximize its revenue. On the contrary, the public sector aims are to reduce the volume of transport and increase the mode of public transport. It is, therefore, necessary to control and regulate these goals.

The authors Muro-Rodríguez, Perez-Jiménez and Gutiérrez-Broncano (2017) also mention that transport is one of the most important services, and the need for mobility increases due to the spatial differences of locations. It is essential to analyse how individual passengers move and their mobility patterns. Disaggregated demand models or discrete choice models are used to determine the probability of choosing from several options (McFadden, 1981; Schakenbos, La Paix, Nijenstein, & Geurs, 2016). To predict the behaviour of transport users, it is necessary to focus on models based on the theory of choice, where the passenger maximizes his utility (Train, 2003). Authors such as McFadden (1974), Manski (1977), or Williams (1977) agree with this and also mention that most models of travel behaviour are based on the theory of utility, and the traveller chooses the most satisfying alternative.

If we take into account personal transport, its development and supply is driven by the demand of residents and tourists for transport from place A to place B. Whether passengers use individual cars or public mass transport depends on their preferences, decisions, and the offered options.

3.1.2 Consumer theory in transport

To offer appropriate transport services, there is necessary to monitor the development of consumer behaviour and to predict future demand better. Following the theories of consumer, it is important to find out about the passengers' decision-making when choosing between individual car transport and public mass transport, or between individual means of transport, such as car, bus, tram, metro, train, bicycle, scooter, etc. The decision depends not only on the available services and means of transport but also on selected preferences. Consumer theory includes two theoretical principles that explain consumer behaviour. The first view is based on

the theory of utility (e.g., Marshall, 1890), and the second on the theory of indifference (e.g., Edgeworth, 1881) – using the substitution, price, and income effects, it explains behaviour during changes in the prices of goods or income and the influence of factors on changes in demand.

Consumer theory

Consumer theory is the part of microeconomics that deals with the decision-making of the rational consumer. The starting point of the consumer theory is the consideration that an individual chooses from different sets of goods (Hořejší, Soukupová, Macáková, & Soukup, 2018). This theory deals with how the consumer distributes his limited income between individual goods in such a way as to maximize his utility based on his chosen preferences. Levin and Milgrom (2004) state that this decision-making has a specific structure, which arises from the assumption that sets of choice sets are defined by prices and consumer income.

According to the view of utility, theoretical economists can be divided into ordinalists and cardinalists. Ordinalists claim that utility cannot be measured. In the ordinalistic approach, it is only possible to compare whether the satisfaction from the selected variant is higher or lower. Cardinalists, on the other hand, perceive utility as measurable (Basler, 2008).

The rational consumer and his preferences are taken into account, while his decisions are made so that the purchased goods or services bring him the greatest possible benefit. Many authors also deal with the axioms of rationality (i.e., defined assumptions), or the theory of bounded rationality. Consumers often make decisions irrationally, and subjectively, and choose suboptimal solutions (Hnilica, 2002; Špalek, 2011; Hořejší et al., 2018). The consumer's optimum can also be determined. In this situation, the consumer chooses the optimal combination of available goods depending on his disposable income, preferences, and prices (Becker, 1997; Zimmermann, 2002; Schiffman & Kanuk, 2004; Basler, 2008).

Following Foret, Procházka and Urbánek (2005) consumers can be classified according to many characteristics, which include, for example, demographic factors (gender, age, occupation, etc.), geographic factors (place of residence or employment, etc.), psychographic factors (lifestyle, social class, etc.) or behavioural factors (market behaviour). Knowledge of consumer behaviour is important for creating strategies and adapting supply to demand. The authors Solomon, Bamossy and Askergaard (2002) also agree with this. There are also so-called "green consumers", which are dealt with by authors such as Moisander (2007), Kashyap and Iyer (2009) or Griskevicius, Tybur and Van den Bergh (2010). These consumers emphasize

ecology, their pro-environmental efforts may have an individual or social interest, and they have this need either to protect the environment or to be seen among others as those who care about the environment. The reasons for green consumer behaviour are various and are influenced by factors such as cultural background, social class, age, etc. Cone (2012) states that according to global research by Edelman PR, green customers are most often people born between 1980-2000, are employed in higher positions, and are married.

Factors affecting consumer behaviour

Decision-making is a set of psychological processes that find the optimal goal and appropriate way of acting in upcoming situations. It is a consumer choice process in which he chooses a preferred option, where information plays an important role. Decision theory includes the theory of consumer behaviour and decision-making as well as the theory of utility (Turčínková, Stejskal, & Stávková, 2007; Winkler, 2007).

The preferences of consumer decision-makers can be represented by a utility function that represents the subjective value of the outcome for the consumer and shows his attitude towards accepting risk. Consumers can prefer and evaluate variants according to the expected utility (Shoemaker, 1980; Merkhofer, 1987).

Consumer decision-making and behaviour are influenced by several factors, which are structured differently. For example, Koudelka (1997) or Zamazalová (2010) divide them into internal and external. Brown (2006) divides these factors into three basic categories – personal, psychological and social. Kotler, Wong, Saunders and Armstrong (2007) add cultural factors to these factors (see Table 1). These 4-factor distributions are the most typical; Solomon, Marshall and Stuart (2006) also agree with them. Grosová (2004) presents almost the same classification, only with different names, namely individual, psychological, social, and cultural factors. Situational factors that create the environment of the decision-making situation are sometimes mentioned as another group.

Table 1 Factors affecting consumer behaviour

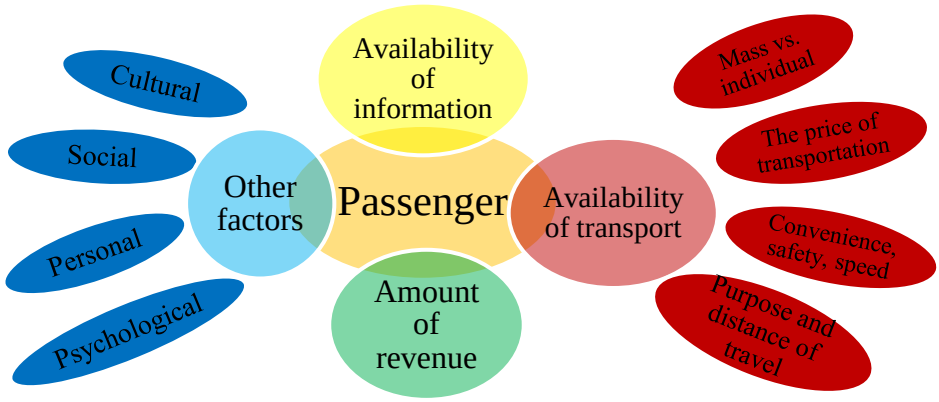
Cultural	Social	Personal	Psychological
Culture Subculture Social class	Reference groups Family Role a social status	Age and stage of life Employment Economic situation Lifestyle Personality and self-perception	Motivation Perception Learning Beliefs and Attitudes

Source: Own (according to: Kotler et al., 2007)

Factors affecting passenger decision making

In transport, the consumer appears as a passenger. As already stated, different degrees of rationality apply to decision-making, and not all individuals make the same decision. The following Fig. 1 summarizes the various factors that influence the passenger and must be focused on in order to understand their behaviour properly.

Fig. 1 Factors affecting passenger decision making



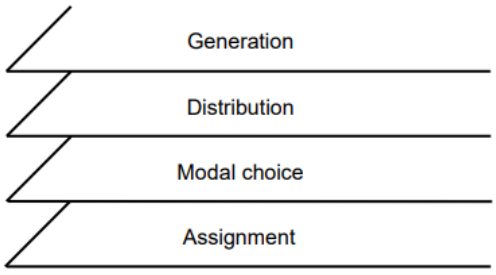
Source: Own processing partially based on Kotler et al., 2007

Among the factors that affect the passenger is the availability of information that is necessary for the possibility of a qualified decision. Further factors are the availability of transport, i.e., the time and location availability of public transport (i.e., at what time and from where it is possible to use a given mode of transport), ownership of a personal car (here it is also a matter of whether the owner also takes into account expenses for wear and tear and the purchase of a vehicle or only the price of the trip itself), the price of transportation by the chosen mode of transport, comfort (condition and cleanliness of vehicles, number of passengers, own driving power, etc.), safety, speed, social prestige, purpose and distance of the trip or consideration for the environment. You can also include the amount of the revenue or, for example, the effect of the weather. As already said, the theory of the consumer takes into account the rational consumer. Therefore, it can be assumed that nowadays, the most motivating factor will be the price of transportation and then the speed (travel time) of transportation, which is suggested for example by Hensher, Stopher and Bullock (2003). There can be other motivating (or discouraging on the other hand) factors, like reliability as a guarantee of realization of the journey and a guarantee to travel on time (e.g. Soza-Parr, Raveau & Muñoz, 2022 or Beirão & Cabral, 2007). Tyrinopoulos and Antoniou (2020) mention further an advanced booking system. Kunhart (2008) also mentions that the passenger perceives the price and time of

transportation as the most important, other factors are reliability, fluency, comfort and previous experience. This leads to the research question Q1: What would motivate travellers to use ITS more?

As stated by Quinet (1998), the modelling of demand for passenger transport can be characterized using a consensus four stages representation, which is microeconomically and statistically consistent with the behaviour of transport agents, and is thus suitable for creating a basic model. Combes and Leurent (2009) mention in their article that the initial intention of modelling the demand for passenger transport was to dimension the road infrastructure and predict the use of different transport options. Models of personal transport are based on models of supply and demand, but supply is described only simply and does not include the behaviour of transport providers. On the other hand, demand (the need to travel, the method of choosing means of transport, etc.) is examined in depth. Initially, the modelling focused only on road traffic routes. Therefore, only three phases were determined - generation (creation of routes), distribution (distribution of routes), and assignment (route itinerary). Later, the choice of mode of transport (choice of means of transport) was added, as competition between modes of transport grew. This resulted in the already mentioned four stages representation of demand modelling (see Fig. 2), which has a hierarchical structure, because a decision at a higher level affects other options at lower levels. The first phase – generation – represents decisions on the location of households, businesses, and various activities. The distribution phase corresponds to the choice of job, the reason for commuting, the choice of schools or shops. On the basis of these decisions, the necessary journeys are created, for which the passenger must choose a suitable mode of transport and finally the journey itinerary. This decision segmentation is a good basis for subsequent modelling.

Fig. 2 Four stages representation of demand modelling



Source: Combes and Leurent, 2009

The personal transport system represented in this way also has its limits. According to Combes and Leurent (2009), the missing elements include, for example, tariff decisions by

providers, the use of a private vehicle by several people, chained routes, the choice of departure time, etc.

One of the factors influencing the passenger's decision is the subjective value of travel time (SVTT). As Jara-Díaz (2007) describes, this value represents the amount a traveller is willing to pay for a unit reduction in their travel time. How much an individual is willing to pay may not be equal to the amount that society is willing to pay, even though the saved time has advantages for it as well, such as a potential increase in working time or an increase in social welfare (greater individual utility). However, reducing in travel time does not have to mean increasing working time (then the social value would be zero). There may be an increase in free personal time, thereby increasing the benefit of the passenger, and this situation can also be considered beneficial for society. The passenger must often choose between a faster but more expensive and a slower but cheaper transport option.

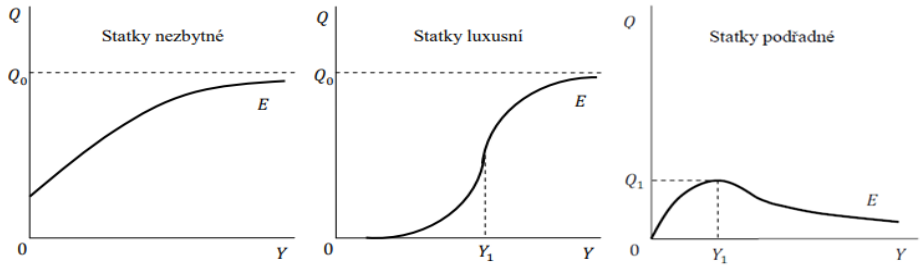
The Engel curve in transport

The Engel curve (EC) expresses the dependence between total income and the amount of goods purchased. It thus shows the relationship between the number of goods or services demanded and the level of income (Pojkarová, 2007). According to Frank (1995), it shows the relationship between the amount consumed and income. The Engel curve is derived from the ICC income consumption curve.

The economic theory divides goods into necessary, luxury and inferior according to individual types of goods. For a necessary good, the EC is concave – the quantity purchased grows more slowly than income. A luxury estate has a convex EC – the quantity purchased grows faster than income. The EC for an inferior good has a negative direction, i.e., it is decreasing because consumption decreases as income increases (Pojkarová, 2007).

Mezník (2005) agrees with this division but specifies it even more closely. They divide goods into normal (which are further divided into necessities (e.g., bread and medicine) and luxuries (e.g., jewellery)) and inferior goods. The quantity demanded (Q) for normal goods increases with increasing income, but only up to a certain limit Q_0. For necessary goods, the demand response is lower, on the contrary, for luxury goods it is large (only up to Y_1) because demand rises faster than income. As shown in Fig. 3, Engel curves are not completely constant, luxury goods are also concave from a certain Y_1. An inferior good declines only from a certain Y_1. It can be said that it is less valuable, but cheaper.

Fig. 3 Engel curve for necessary, luxury and inferior goods

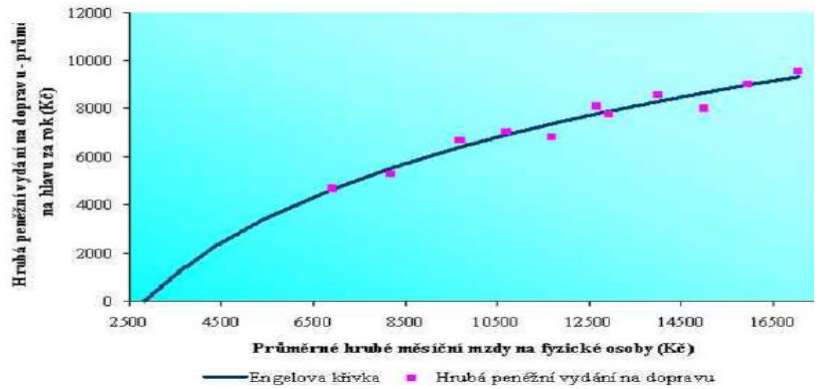


Source: Mezník, 2005

Pojkarová (2007) studied data from the transport yearbooks of the Ministry of Transport of the Czech Republic and data from the Czech Statistical Office: It can be established that there is a dependency between gross household income and household expenditure on transport and that both values are gradually increasing for the years 2000–2016. The values of gross monetary expenditure on transport include expenditure on the purchase of personal transport means, on their operation, as well as on mass passenger transport and an almost negligible amount on freight transport. The highest item is the purchase of fuel mixtures and the purchase of passenger cars. The share of expenditure on mass transport (public transport, bus, train, taxi, air and water transport) is stable at around 13-14%. Research question Q2: Is the household income related to their transport expenditure? was deduced from the above information.

Pojkarová (2007) also presents in her work a graph that shows the Engel curve of transport expenses from data for the years 1994-2004 (see Fig. 4). The value of the coefficient of determination is about 95%, therefore, all the variability of the values can be explained by the model mentioned. From the shape of the curve, we can conclude that transport is neither a luxury nor an inferior commodity. It is impossible to say with certainty whether it is a normal or necessary good because in some periods transport expenditure has increased less than income, in other periods it has increased more.

Fig. 4 Engel curve of transport expenditure



Source: Pojkarová, 2007

The elasticity of demand for transportation

Economists want to predict the effects of a change in one variable on another, which is precisely what elasticity is used for (Mezník, 2005). As Kennedy (1982) and Basler (2008) stated, Alfred Marshall, who defined the term elasticity in 1881, is an important figure in this field. He defined the price elasticity of demand as the percentage change in quantity demanded for a one per cent change in price. He described point elasticity, which applies to small price changes and can be written by the formula:

$$E_d = \frac{dQ/Q}{dP/P}, \quad (1)$$

where: E_d – price elasticity of demand at a given point, dQ – change in quantity demanded, Q – original quantity demanded, dP – change in price, and P – original price. If the absolute value of the price elasticity of demand is greater than one, it is elastic. If it is less than one, demand is inelastic. As Kříž (2014) mentions, in the case of inelastic demand, when the carrier raises prices, he expects higher revenues. According to Melichar's (2002) calculation of the values of the coefficient of relative elasticity, it turned out that the total demand for public transport (as well as passenger transport by ČD trains) is inelastic (when transport prices increase, demand decreases more slowly than price increases). In transport, as a rule, there is a slightly elastic demand. Melichar (2002) explains the difference between direct price and cross (indirect) elasticity. Direct elasticity means the dependence between the volume of demand and its price (e.g., in passenger rail transport). Cross elasticity expresses the dependence of the volume of demand on the prices of substitutes or other transport services or modes of transport (e.g., the demand for driving a car also depends on the characteristics of bus and train journeys). The cross-elasticity in transport can be related to all the properties of the transport system and it can be determined whether transport is substitute or complementary. This is also agreed by Melichar and Ježek (2004), who express the cross-price elasticity as the price of other services, while carriers are interested in the reaction of a change in the price of the service of other competitive modes of transport. We can also mention examples of elasticity that is not related to price but, for example, to the quality or level of services. In his work, Kříž (2014) presents demand elasticities depending on supply attributes. As an example of inherent elasticity can be E_d = -1 means that if travel time is reduced by 10%, demand will increase by 10%. Furthermore, a direct connection without transfers generates 12% more demand. An example of a cross elasticity of travel time with a value of 0.4 is that a 10% increase in individual car travel time due to congestion causes a 4% increase in demand for public transport.

Melichar and Ježek (2004) mention that according to the basic factors that influence the demand for transport, income elasticity is also examined in practice. Income elasticity indicates the extent of changes in demand depending on the change in consumer income.

There are factors that determine the elasticity of demand. Frank (1995) includes among these determinants:

- The possibility of substitution – the availability of substitutes is decisive (goods with good substitutes have greater elasticity of demand).
- Share of the budget – share of the estate in total expenses (the higher the share, the higher the elasticity).
- Direction of the income effect (necessity of goods) – due to the influence of the income effect, which increases the substitution effect for normal goods, there is a higher elasticity than for inferior goods, where the substitution effect weakens.
- Time – division of the time horizon – elasticity is low in the short run, while demand is more elastic in the long run.

Many authors, including Levin and Milgrom (2004), mention (and build on the theory of Professor Hicks - see Machlup, 1940) that the effect of a price change can be divided into two effects – substitution effect (SE) and income effect (IE) – which together form the total effect (TE). The substitution effect shows the change in quantity demanded due to the substitution of a relatively more expensive good for a relatively cheaper good. It is a shift along the indifference curve and is always negative. The income effect means that the quantity demanded changes because of a change in income. This is a change in the indifference curve and, thus, utility. It is negative for normal goods, and positive for inferior goods. Both of these effects can be found in transport, because when the consumer has, for example, a smaller income, he uses transport services less (income effect). The substitution effect can be clearly seen at present time, when due to the increase price of fuel, the consumer is more likely to choose public transport or walking instead of individual car transport.

Motivation and stimulation to use public transport

Currently, transport by private car is more attractive than public mass transport, because it is faster, more comfortable, more convenient, more reliable, the passenger has a feeling of freedom and a better social status (Hagman, 2003). In order for passengers to choose public transport or an integrated transport system (ITS), it is necessary for them to have sufficient information and to be motivated or stimulated. According to Schödlbauer (2009), positive

motivation is needed and it is necessary to show positive aspects, such as comfortable, modern and safe vehicles, frequency of connections, speed and smoothness of driving (public transport has the right of way, its own lanes, etc.). It is also possible to mention additional services, e.g., WIFI connection, chargers, the possibility of transporting bicycles, carsharing, etc. A high-quality ITS then offers easy movement around the city and surrounding areas, easy orientation and purchase of single tickets, and continuity of connections. Another positive is the lower price, friendliness to the city (lower noise and less congestion), that is mentioned namely in connection with Southern Europe (e.g. Pichler-Milanović, 2007 or Slaev et al., 2018) and environmental friendliness (fewer emissions) – e.g. Serafini Nigro, Gatta and Marcucci (2018) or Das, Ladin, Ismail and Rahmat (2013).

The ecological aspect is now a much-discussed topic. Society tries to behave pro-ecologically, there are also so-called "green consumers", but it is necessary to distinguish between a genuine interest in the environment and a mere attitude for the sake of social prestige. As already stated, we consider a rational consumer who is primarily concerned with his own utility. Also, Nilsson and Küller (2000) state that the environmental aspect is not important for commuters because they focus on comfort and their own needs in their daily travel. The research showed that many households owned more than one car. Therefore, the research question Q3 was chosen: Do workers look out for the environment or prefer greater comfort in their daily journeys?

3.1.3 ITS management

Business process management

For the effective integration and for all interested parties to cooperate properly, it is necessary to have established internal and external processes that follow each other. For this, business process management (hereinafter referred to as BPM), i.e., management of business processes, its compliance and controlling, or even a business ecosystem is necessary (Cabrera-Moya & Prieto-Rodríguez, 2022). For these processes to be functional, their information and knowledge support are also important, which can be secured using expert systems. Even in the field of public transport, it is necessary to focus on BPM, especially in the integration and cooperation of several transport entities managed by the transport coordinator.

Business process management deals with the management of business processes. It is a set of activities that deal with the planning, implementation and monitoring of the performance of individual company processes (Smart, Maddern, & Maull, 2009). BPM also deals with the

implementation of an automated and integrated process, helps reduce business costs, can eliminate human errors and process gaps, and increases the overall efficiency of business processes. A business process includes a series of events and activities, where events are automatic actions (e.g., the arrival of equipment at a construction site) that do not have a specific duration and can trigger a series of activities (Zur Muehlen & Shapiro, 2015). At the end of the process, one or more results should be achieved, ideally the result should bring value, but it can also be negative (Weske, 2007; Dumas, La Rosa, Mendling, & Reijers, 2013).

In the 20th century, companies typically had organizational structures that were focused on individual functions of specialists performing specialized tasks, and individual processes functioned in isolation. However, the functional management of enterprises creates a number of problems (e.g., local limitation of functions, insufficient communication between departments, etc.), which is why they are switching to process management. This transition is one of the most important changes that affects all employees and the entire company, because there is a change in the organizational structure. During the 21st century, BPM has become a mature discipline that has a well-established set of methods, tools and principles combining knowledge from management sciences, information technology and industrial engineering and aims to streamline and improve business processes (van der Aalst, 2004; Weske, 2007; Dumas et al., 2013; Harausová, 2014).

There are countless definitions of BPM, but they all agree on a single principle. They include, for example, the definition by Weske (2007), who states that every product or service provided is accompanied by a series of business processes, which consist of a set of activities carried out in a coordinated manner in a technical and organizational environment. Individual activities together fulfil a business goal, with each business process being a key tool to better organize these activities and enact for one organization. BPM includes methods, techniques and concepts supporting business process design, management, configuration, and analysis (e.g. Weske, Van Der Aalst, & Verbeek, 2004; Ko, Lee, & Wah Lee, 2009). The International Association of Business Process Management Professionals (ABPMP, 2021) describes business process management as a disciplined approach to identifying, designing, implementing, measuring, monitoring, documenting, and managing business processes, which may be automated or non-automated. The purpose is to achieve consistent results that are in line with the company's strategic goals. The essence of BPM is the continuous improvement and innovation of current company processes through the improvement of specific work activities (within departments,

across the enterprise, or between organizations) in order to achieve effective company performance.

It is, therefore, a set of tools, techniques, procedures, and methods to support the design, approval, management, and analysis of processes with the aim of managing, leading, and improving the company's portfolio of processes and providing their maximum performance (Schulte, Janiesch, Venugopal, Weber, & Hoenisch, 2015; Maříková, Rolínek, Kubecová, & Vrchota, 2015; Stuit, 2012). The processes themselves can be structured and repeatable, or unstructured and variable (Jeston & Nelis, 2006). Rolínek (2008) states that process management is a systematic identification and visualization, and measurement and evaluation of processes is needed for their continuous improvement. Established methods and principles based on a process approach are used for this. At the same time, great emphasis is placed on information systems that ensure the necessary amount of information in the required quality and, the level of human resources is emphasised. The essence of process management is an orientation towards making processes more efficient.

The introduction of process management is complex and can be risky, so it is necessary to state the benefits and advantages that process management offers in the company. The main benefits are quality and accuracy, and increased ability to react to changes or process efficiency. BPM is used to cope with changes in the economic environment and is considered the best guiding principle that helps companies maintain a competitive advantage. Radeschütz, Schwarz and Niedermann (2015) mention that in today's dynamic world, the ability to constantly adapt business processes is essential, so it is necessary to analyse company data thoroughly. Maříková et al. (2015) agree with the above-mentioned authors, but according to her, BPM has an advantage only in times of crisis. Otherwise, the introduction of BPM is rather voluntary, for example, due to changing customer requirements. Radosevic (2014) also agrees with this, claiming that BPM is an important part of business management, which increases competitiveness and sustainability in uncertain times with constant changes. Hammer (2010) and Kohlbacher (2010) deal with other research on the benefits of BPM.

Each business process also has its own life cycle, which consists of phases: design and analysis, configuration, enactment, evaluation and management and stakeholders, which include many processes and procedures (Weske, 2007). Dumas et al. (2013) summarize BPM more simply as a continuous cycle of phases: process identification, process discovery (modelling), process analysis, process redesign (improvement), process implementation, and process monitoring and control. Many authors deal with the life cycle of process management,

but they all arrive at the same essence already mentioned. Like Weske (2007), van der Aalst (2004) and Netjes, Reijers and van der Aalst (2006) focus on information systems and the configuration phase in which the system is set up and adapted and then implemented. Authors such as Houy, Fetke and Loos (2010) or Muehlen and Ho (2006) depict the life cycle in more detailed steps and mention the importance of strategic goals.

Stašák (2010) divides business processes into the core, main, supporting and management, which have an exceptional position, while all processes have a multi-layer hierarchical vertical or horizontal structure. Business process models are represented using diagrams that contain basic sets of elements and complete sets of elements. Core Elements express simple structures and are easily understood even by designers without extensive training (Weske, 2007). By consolidating related literature, merging existing BPM maturity models, and subsequent case studies, a set of six defined factors that determine a holistic perception of business process management have emerged (de Bruin, 2009). From the results of international Delphi studies involving BPM experts from Europe, the USA and Australia, the areas of application of each of the factors were identified (de Bruin & Rosemann, 2007). According to many authors, the basic elements are strategic alignment (synchronization), management (governance), methods (set of tools and techniques), information technology, people (individuals and groups) and culture (Elzinga, Horak, Lee, & Bruner, 1995; Hung, 2006; Pritchard & Armistead, 1999; Zairi, 1997; Zairi & Sinclair, 1995; Hammer & Champy, 1993; Spanyi, 2014).

BPM in ITS

Process management can be implemented in all companies. Therefore it can also be discussed in connection with public transport and the ITS. In order for people to switch to using an ITS, it is essential that it is functional and that all processes are properly managed and secured. Integrated transport management includes continuous planning, optimization and management of transport networks. Companies such as 4flow offer customers an outsourcing solution for this integrated management, thus taking over the entire BPM and ensuring flexibility and cost reduction of the business thanks to their expertise, capacities and software technologies.

As stated by Nedeliaková and Nedeliak (2013), BPM combines technologies within ITS and the requirements of the customer, who must constantly monitor and subsequently map, adjust and optimize business processes and ITS as needed so that process control is effectively implemented. Various information and communication technologies are often used in transport

in order to improve and optimize it, which is also agreed by Schnieder, Wermser and Barrilero (2014). BPM represents a new approach to process management within ITS and contributes to high efficiency of processes, especially in the following areas: production, operation, logistics, finance, accounting, HR, payroll, planning.

As Vick (2013a) states, any functioning system is an inseparable combination of processes, people and technology working together. To implement a smart integrated transport system, the following steps need to be included:

1. Vision setting
2. Introduction of technology
3. Work on integration
4. Adding innovation
5. Cooperation during management

As already mentioned, the core elements of BPM are strategic alignment, management, methods, information technology, people, and culture. These elements are very close to the mentioned business management to achieve sustainable transport and Smart City. For comparison, they can be seen in Table 2 (Vick, 2013b).

Table 2 Basic elements of BPM and steps to a Smart City

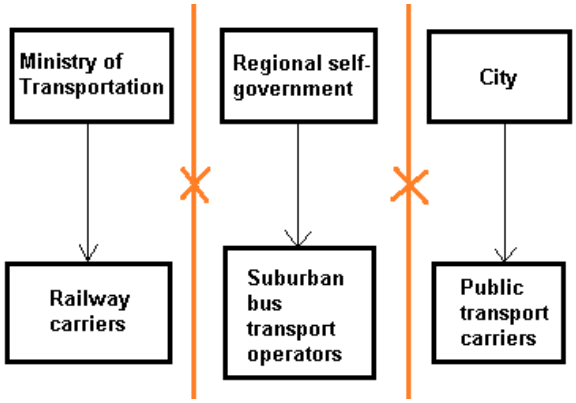
Basic elements BPM	**Steps to a Smart City**
Strategic alignment	Vision setting
Management	Introduction of technology
Methods	Work on integration
Information technology	Adding innovation
People	Cooperation during management
Culture	

Source: Own (according to: Vick, 2013b)

The mobility of the city and surrounding areas is ensured by multiple carriers and companies with different areas of responsibility and differently set management systems. As Vick (2013a) states, ITS aims to integrate operations, but in the past, it has always been a bigger challenge to get the entities to work together than to synchronize the technologies themselves.

In order for this connection of multiple carriers to work, the system must be managed and organized by a coordinator or integrator (or organizer) of the integrated transport system (Mrníková, Poliak, Šimurková, & Reuter, 2018). The task of the coordinator is to coordinate relations between ITS entities. Fig. 5 shows that personal public transport systems without a coordinator operate on a two-level organization model. In such uncoordinated systems, contractual relations are only bilateral, and there is no cooperation between transport orderers and carriers, but only between service providers and specific carriers.

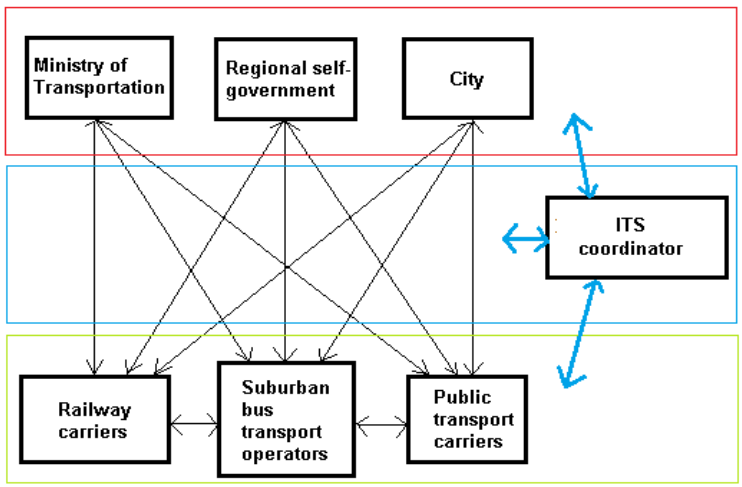
Fig. 5 Two-level model of public transport organization (without coordinator)



Source: Own (according to: Mrníková et al., 2018)

After the establishment of the ITS coordinator, a three-level organizational model will be created (see Fig. 6), where individual ITS subjects cooperate with each other. The coordinator thus ensures contractual relations, redistribution of sales, unification of conditions, timetables, tariffs, etc., does not have the function of a carrier, but acts on behalf of transport customers and concludes mutual contracts (Mrníková et al., 2018).

Fig. 6 Three-level model of public transport organization (with coordinator)



Source: Own (according to: Mrníková et al., 2018)

The main and indispensable condition is that the system must be organized and managed by all recognized authorities, this is the so-called "integrator" or "organizer" of the integrated transport system, which is the strongest position within the ITS. As stated by Poliaková and Kubasáková (2014), the coordinator of the ITS should be responsible for:

- the organization of transport services by public transport,
- monitoring and evaluation of transport,
- optimization and control of financial flows,
- designing and implementing an integrated tariff system,
- preparation of ITS development phases, etc.

If these responsibilities are not clearly defined, a problem arises at the beginning of planning, as the authorities cannot agree with the operators. According to Mrníková et al. (2018), the coordinator (i.e., the established company) should organize, plan, manage, control, develop and build the ITS while representing the interests of the participating entities. Its main task is to ensure transport performance in the required range and quality, while it must:

- contractually ensure mass transport of people in the given area,
- control the quality of the performance of individual carriers,
- propose financial security and the subsequent share of individual entities,
- guarantee compensation to the carriers for objectively determined costs, reproduction and profit,
- propose legislative changes to support ITS.

BPM in the transport industry must adapt to the needs and requirements of the customer. Public mass transport is a non-profit sector, but the ITS coordinator must ensure the transport service of the territory under the specified conditions. As stated by Vick (2013b), the goal of ITS is also the integration of urban transport systems with regard to public services, safety, etc. Thus, information and communication systems that make traffic management more efficient and easier and include, for example, sensors, cameras systems, signs, dynamic messages, and signalling security. At a basic level, a decision support system can be designed that is similar to a BPM system. It thus includes steps for managing emergency traffic and informs interested parties (firefighters, paramedics, etc.). BPM is, therefore, also an information technology system, which Schnieder et al. (2014) and Drdla (2011) also agree on.

A specific feature of BPM in the field of transport is mobility management - also known as Transport Demand Management (TDM). It is a strategy that makes the transport system more

efficient and consists of different techniques, approaches, policies and programmes. Mobility management offers both economic and social benefits. Many authors discuss this broad topic, including Litman (2008); Salleh, Rahmat and Ismail (2015) or Enoch (2012).

State of the art

The task of transport planning is also to balance the demand for transport with its supply, or the capacity of the transport system. This equilibrium state is difficult to achieve, and often the demand is too high, or on the contrary, the transport offer is not used effectively. Using statistics for 17 EU countries, an updated study of the external transport costs by Schreyer et al. (2004) provides estimates of congestion costs. Using welfare theory to account for the costs of inefficient use of existing infrastructure, the resulting costs are €63 billion (over 0.5% of GDP). If the optimal amount was collected for congestion charging, the revenue would be 753 billion euros (8.5% of GDP). The cost of the time loss indicator would be €268 billion (3% of GDP). The total external costs of transport for companies without congestion amount to €650 billion (7% of GDP), of which climate change accounts for 30%, air pollution 27%, accidents 24%, noise 7% and landscape impacts 5%. According to the type of transport, road transport has the largest costs (84%), air transport accounts for 14% and the rest is rail and water transport. Passenger transport accounts for two thirds of the total costs. In 2000, Western European countries invested approximately €90 billion (1% of GDP) in transport systems, of which 80% was used for road transport (Schreyer et al., 2004).

As reported by Salleh et al. (2015), using the results of a study from seven experts, several dozen strategies for implementing TDM to actively use transportation were proposed. Taking into account the selected elements and the selected specific objectives, the three best strategies were selected, one of which concerns the reduction of congestion.

Research on transport evaluation indicators and public (or urban) space evaluation indicators recorded on Web of Science and Scopus mostly appeared after 2000. The work of European researchers accounts for 73.4%, Asian 28% and North American researchers 13.7%. A study by Yang, van Dam and Zhang (2020) classified transportation and spatial system integration into the following three levels - internal integration, integration between subsystems, and integration between the system and the external environment. For this hierarchy, sets of goals and objectives for transport infrastructure reconstruction projects are also proposed. The study thus presents topics and indicators for the evaluation of transport and spatial systems.

Research carried out in Slovakia in 2012 showed that information and communication technologies help the transport company especially in the areas of monitoring, measuring and evaluating own performance and further digitization of archives. This fact helps to understand the company's own processes and thus to the high efficiency of operational management processes. The quality of information and communication technologies has a positive effect on the quality of the services offered, which affect customers (Nedeliaková & Nedeliak, 2013). ICT technologies can also help in the management of public transport services in real time using the communication of individual public transport vehicles, these are so-called cooperative intelligent transport systems (C-ITS). A survey of experts using C-ITS in various European cities showed, among other things, the improvement of mobility through the reduction of delays and reduction of travel times, which can be an argument for passengers to use public transport services (Lu et al., 2018). Hepner, Zhao, Seipel and Hoyer (2021) also demonstrated the benefits of optimizing traffic on roads and shortening commute times as part of the experiment in real terms.

A beneficial study on commuter employees was conducted in 2021 in the Netherlands. Several combinations of ITS were determined with the aim of finding the preferred mode of transport together with the effects of price and tariff changes. Among other things, it was found that 54% of car users would not switch to an alternative mode of transport to work. Non-car users preferred train + bus/tram/subway, while car users preferred train sharing + electro bike and car sharing + e-bike sharing. Including e-bike sharing increased the probability of choice by almost 11%. Substantial differences between different age groups were also revealed; young people are more willing and open to change and alternative modes of transport (Farahmand, Gkiotsalitis, & Geurs, 2021).

3.1.4 Investments in ITS

Transport and its integration bring benefits for passengers. To make transport smooth and comfortable, it is necessary to invest in its various elements, including infrastructure, vehicles, information and telematics systems, equipment, security or stops. The goal is to create an efficient and comfortable transfer for passengers from point A to point B.

The concept of investment is used in economics as part of the finances invested in long-term projects that only bring benefits in the future. Investments can be defined from a macroeconomic and microeconomic point of view. Valach (2010) defines investments in the macroeconomic context as economic activities of a subject (state, company or individual) in

which current consumption is given up in order to increase the production of future goods. Investment thus marks the transition between the present and the future economy. In the microeconomic context (in the field of financing) it is the monetary expenditure of a business that generates income over a longer period of time. In the broadest sense, investments are defined as spending a certain current value to an uncertain future value (Korytárová, 2002). Kislingerová (2010) identify with these definitions. Many similar definitions can be found in the professional literature, which point out that when investing, a company gives up a part of its savings for the purpose of future income (for obtaining a benefit), although future values are not certain, and investment brings risks. As Bednařík (2012) mentions, future benefits can be monetary or non-monetary, such as the purchase of new machines, the development and research of new products, or the acquisition of human capital.

As stated by Kuchař (2013), from a macroeconomic point of view, it can be said that the effect of investments can be sharp changes that affect aggregate demand and thus also employment. For example, investment in transport infrastructure creates new jobs in the construction industry, but also in subsequent subcontractors.

Investments are very important for the national economy. One of the basic aspects of economic growth is capital formation, therefore, in the case of economic growth, the state must invest. By increasing the number of buildings, equipment, infrastructure, etc., there is an increase in the potential national product and, thus, economic growth in the longer term, which is reflected in the rate of growth of the gross domestic product (GDP). Korytárová (2002) demonstrates this fact with the following formula for calculating GDP using the expenditure method:

$$GDP = C + Ig + G + X, \tag{2}$$

where: C – is household consumption expenditure, Ig – is gross domestic investment (includes expenditure by business sectors on capital goods and expenditure on changing business inventories), G – is government expenditure on the purchase of goods and services (including investment in transport infrastructure) and X – is net export (i.e., trade balance).

A specific type of investment is a public project, which is a proposal to invest funds in a public asset. It brings benefits to society and is supposed to satisfy public needs. Public projects usually take the form of investment (Dragoun, 2017). Mališová and Malý (1997) state the conditions, of which at least one of the public projects must meet:

- Financing a significant part of the project is through public investment systems,

- other economic policy tools are used for its implementation, such as price regulation by the state,
- significant externalities are associated with its implementation.

As mentioned by Kislingerová (2010), the motivation of public benefit projects is not earnings, but the effects it will bring. These projects are usually implemented by non-profit organizations, but they are also in a commercial environment, for example to obtain subsidies. Ochrana (2004) points out that this type of project is implemented in the form of a public contract and there should be a choice between the zero variant (no change occurs, and the consequences of leaving the current state are determined) and the change variant (change occurs, the assumed future state is analysed).

Financing of the investment project

There are several possible sources of financing investment projects, and they are most often divided according to their origin and ownership relationship. This classification according to Kislingerová (2010) can be seen in Table 3. In his work, Dragoun (2017) analyses the project's financial structure and points to the inclusion of national resources and grants from the European Union. According to the implementation guidelines for evaluating the effectiveness of project investments (MDČR, 2013), the total resources of the applicant include own and other resources, the total financial resources without reserve include credit, state budget resources, national resources and EU grants. In order to obtain total resources, reserves of own resources and EU grants are added.

Table 3 Sources of investment project financing

Origin of resources	**Resource ownership**		
		Own	**Foreign**
	Internal	profit depreciation	corporate bank pension reserves
	External	deposits of owners subsidies and donations risk capital	business or bank loans bond issues financial leasing other liabilities

Source: Own (according to: Kislingerová, 2010)

Evaluation of the effectiveness of investments

According to Valach (2010), efficiency expresses the effectiveness of converting inputs into output, and for an investment to be effective, the income from the investment must be higher than the costs incurred. The main reason for evaluating the effectiveness of investments is to

decide whether to accept or reject a given investment. Scholleová (2009) adds to this that a qualified decision is made whether to implement the investment, suspend it, or choose the most suitable variant from several projects. The findings from the conducted studies are used here, which are transferred to the economic level, and a financial investment plan is created, based on which a financial evaluation of the impact of the investment on the value of the company (i.e., its effectiveness) is carried out. Synek (2007) in his book Managerial Economics presents the following steps for the correct evaluation of the effectiveness of investments:

1. Determination of the capital expenditure of the investment (e.g., the purchase price of the investment).
2. Estimation of future income from the investment and estimation of the risks it may bring.
3. Determination of the cost of own company capital (corporate discount rates).
4. Calculation of the net present value of income and comparison with investment expenses.

As stated by Fotr and Souček (2011), cash flow (CF) is the basis for assessing project viability and is key in evaluating economic efficiency and return on investment. Net cash flow is determined as the difference between income and expenses and thus expresses the excess or lack of cash resources. The basic breakdown of CF corresponds to business activities, i.e., it is divided into cash flows from operating activities (e.g., payments to suppliers and employees, income from customers, etc.), cash flows from investment activities (expenses for the purchase of buildings, machines, land, etc., or income for the sale of long-term assets) and cash flows from financial activities (income and expenses for obtaining or returning resources – loans, bonds, etc.) (Kislingerová, 2010; Nečas, 2012). Together, these three areas form a pure CF. In their work, Fotr and Souček (2005) mention that it is necessary to clarify the purpose of cash flows, i.e., to distinguish whether cash flow is used for evaluating economic efficiency - there are investment and operating CF (full own financing is assumed) or for commercial assessment viability (i.e., financial stability) – include investment, operational and financial CF.

The ideal would be a liquid investment with high profitability and no risk, but in reality, this case rarely occurs, often profitable investments are more risky and vice versa (Synek, 2000). For projects where there is no direct financial benefit (e.g., mandatory projects), financial criteria may have limited applicability. The most used criteria in practice are net present value and internal rate of return (Valach, 2010).

Several methods are used to evaluate the effectiveness of investments, but it is necessary to assess whether a specific method is suitable for a given project. Jindráčková (2019) and other

authors divide these methods into statistical and dynamic. Synek (2007) in his book describes the individual methods in more detail and states that dynamic methods (e.g., the method of profitability or payback period) take into account the effects of time and risk factors, while statistical ones (e.g., the method of net present value or internal rate of return) do not.

The approach to evaluating the effectiveness of public benefit projects is somewhat different. For example, the authors Soukupová (2006), Kislingerová (2010), or Kopecký (2012) deal with this topic. According to the classic assessment, these projects can be rejected as unprofitable, but their benefit to society and the possibility of co-financing from European sources and subsidies must be taken into account. In the case of this type of project, it is not a matter of positive cash flow, but the meaningfulness must be evaluated (Baranauskiene & Alekneviciene, 2014). Public projects can be evaluated using qualitative and quantitative evaluation methods, quantitative methods are further divided into single-criteria and multi-criteria. Among the most used single-criteria methods are the following input-output (or cost-output) methods:

- Cost Minimization Analysis (CMA) – not measured.
- Cost Benefit Analysis (CBA) – monetary units are measured.
- Cost Effectiveness Analysis (CEA) – the number of output units from the realized unit of costs is measured.
- Cost Utility Analysis (CUA) – the benefit from the project is measured.

Non-market valuation of benefits and costs in monetary units when evaluating environmental public goods can be done using the WTP (Willingness to Pay) or WTA (Willingness to Accept) methods. Melichar and Ježek (2004) state that evaluating the effectiveness of transport investments requires a detailed analysis of revenues and costs and a forecast of transport demand. Revenues from transport investments can be taken, for example, as profit from realized transport and tolled transport routes, but also the positive effects that investments have on the development of the state and region and on the environment. As Dragoun (2017) states, if the project draws from European funds, the rate of co-financing must be calculated according to the valid document setting the rate of support from European funds. 85% of the calculated decisive amount is financed by the EU Cohesion Fund and 15% is paid from the budget of the transport customer (i.e., from the budget of the Ministry of Transport of the Czech Republic or the budgets of individual regions).

ITS investment

Transport is one of the most important sectors of the economy and its importance is increasing. As Bok and Kwon (2016) mentioned, urban public transport has been more addressed in recent years due to increasing intest in ecology and improving the quality of life in cities. When evaluating the quality of transportation, one of the most important factors is the transportation infrastructure. In order for the transport infrastructure to be safe and reliable, it is necessary to pay attention to its quality, the correct range and to constantly modernize it. For this, it is necessary to spend large funds, which are usually from public budgets; therefore, it is necessary to invest them effectively.

According to Smith (2001), already in 1776, the sovereign or the state was obligated to build and maintain public buildings that benefit society, they may facilitate trade, but their benefit would not replace the expenses incurred by the individual. Examples of these structures include roads, bridges, harbours and navigable canals.

Transport infrastructure can generally be made up of road, rail, air and water transport infrastructure. Freimann (2002) further divides the transport infrastructure into two parts:

- own transport route – communication, connecting nodes and equipment,
- commercial equipment – fixed equipment for commercial purposes (ramps, depots, garages, loading docks).

Furthermore, Freimann (2002) explains the relationship of the carrier to the transport route. In the first case, the road is owned by the owner, who alone has access to it. The second option is a road that is public property, owned by the state and accessible to all. The owner of the transport infrastructure has ownership rights and can be an administrative unit or a private person – in the Czech Republic they are:

- State – motorways and first-class roads, railways.
- Region – second -class roads and third-class roads.
- Municipality - local communication.
- Legal or natural person – purpose-built roads, railway sidings, railway lines of minor importance.

In the Czech Republic, there are many new options for investing in infrastructure, some of which are also mentioned by Kuchař (2013) in his work. These are mainly investments in the construction and modernization of expressways, motorways, and railway corridors, which are

part of important European routes. The next is also the electrification of railway lines. Other opportunities related to ITS are, for example, investments in more ecological vehicles (electric cars and their charging, shared bicycles and scooters, etc.), the construction of P+R parking lots or the improvement of telematics and information systems. Benefits from investments include, among other things, saving time and fuel, reducing wear and tear on the means of transport and the probability of a traffic accident, benefits for society, the environment, and economic benefits (Kuchař, 2013; Vickerman, 2017). The transport policy of the Ministry of Transport of the Czech Republic (MDČR, 2021) for the period 2021–2027 defines the set goals and measures to achieve them. The involvement of individual transport in a multimodal chain is addressed here, especially P+R (or B+R) parking lots on the outskirts of cities with links to public transport or at terminals (e.g., also at train stations). These parking lots should be equipped with charging stations or autonomous vehicles that can be shared. Due to the large concentration of people in cities, there is a high demand for mobility, therefore, it is important to regulate mobility and reduce excess traffic and transport performance. The goal for sustainable mobility is the lowest possible share of individual car transport, which can be replaced by alternative means of transport (public mass transport, cycling and pedestrian transport, etc.). It is also stated here that women are more likely to use these alternative modes of transport, but convincing men to use individual transport less is important. Here it would be appropriate to deal with research question Q4: Does the use of alternative modes of transport depend on the gender of the passenger? Public transport also reduces the negative impact of cars, improves the quality of the environment and public life (MDČR, 2021).

Jana Gotvaldová (2014), head of the department of transport statistics and information and communication activities, states that high-quality and functioning transport systems are necessary for a strong economy and the satisfaction of citizens. The traffic situation can be evaluated using financial indicators (e.g., sales, profit) or natural indicators (number of passengers transported, kilometres traveled, etc.). Transport performance is dependent on the quality and density of the transport infrastructure and the size and quality of the vehicle fleet. The Czech Republic has a significant dense railway network, but the motorway network is insufficient due to the increase in individual traffic. Despite the investments made in the vehicle fleet's modernisation and the transport infrastructure's development, the level for high-quality, safe and fast transport is still not reached. More investments are needed so that the Czech Republic can be a European transport crossroads (Gotvaldová, 2014).

The specifics of transport from a financing point of view

The specificity of transport is that it is a provided service. It can be a public or private service, in the case of ITS there are both variants. As mentioned by Mononen, Leviäkangas and Haapasalo (2017), public services are under more control due to a society that is increasingly less willing to invest in them. Using decision analysis based on multiple criteria, he created a process for evaluating the socio-economic benefits of public transport. They assessed the return on public investment using the benefit-cost ratio (B/C). According to the results, it was found that these B/C ratios were greater than or equal to one, so the investment in services paid off.

As already mentioned, public mass transport is a non-profit sector, and since it is provided by the public sector, it can be called a public good. This estate must be financed from the public budget, unlike private estates (Holman, 2011).

Public transport is provided for the needs of the city and suburban areas. This transport is subsidized from the municipal budget, and the state also participates in the subsidies by allocating funds for the purchase of public transport vehicles. As reported by Křivda, Folprecht and Olivková (2006), the organizational structure of ITS consists of subjects and the links between them.

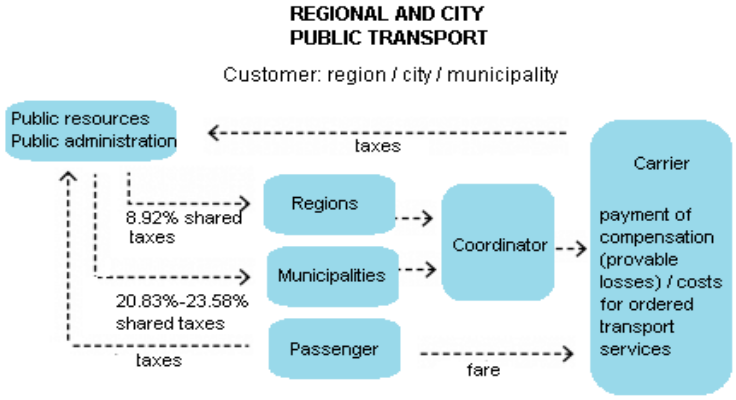
Specifics of funding sources

As stated by Novotný (2020), the public administration is responsible for ensuring transport services, which acts as a customer of public services and orders a certain volume of transport services from the carrier (e.g., number of connections, service of specific lines, etc.) in a specified period of time. At the same time, the customer determines the fare and tariff. In the case of ITS, the function of the client is assumed by the organizer (or coordinator) of the ITS, who assumes the role on behalf of several clients, to whom they delegate their competences. In the Czech Republic, so-called regionalization is applied and public transport is ordered by three types of customers:

1. Cities and municipalities – provide transport services on their territory, order transport services within the framework of public transport, or may participate in regional bus and train connections (if they are used to ensure intra-city transport relations).
2. Regions – order regional bus and railway lines.
3. State – orders interregional and interstate train services (high-speed trains and express trains).

Palkovská (2015) adds to this that these definitions are vague and at the same time overlap. A similar regionalization system exists in almost all developed EU countries. Financing is partly provided by fare sales and partly provided by the budget of the relevant client (i.e., the budgets of regions, cities and municipalities and the state budget). The share of cost coverage depends on the set amount of the tariff. Since public transport fares are low in the Czech Republic, the greater part of the finances must be secured from public budgets. Fig. 7 shows the principal scheme of ordering and financing public transport in the Czech Republic.

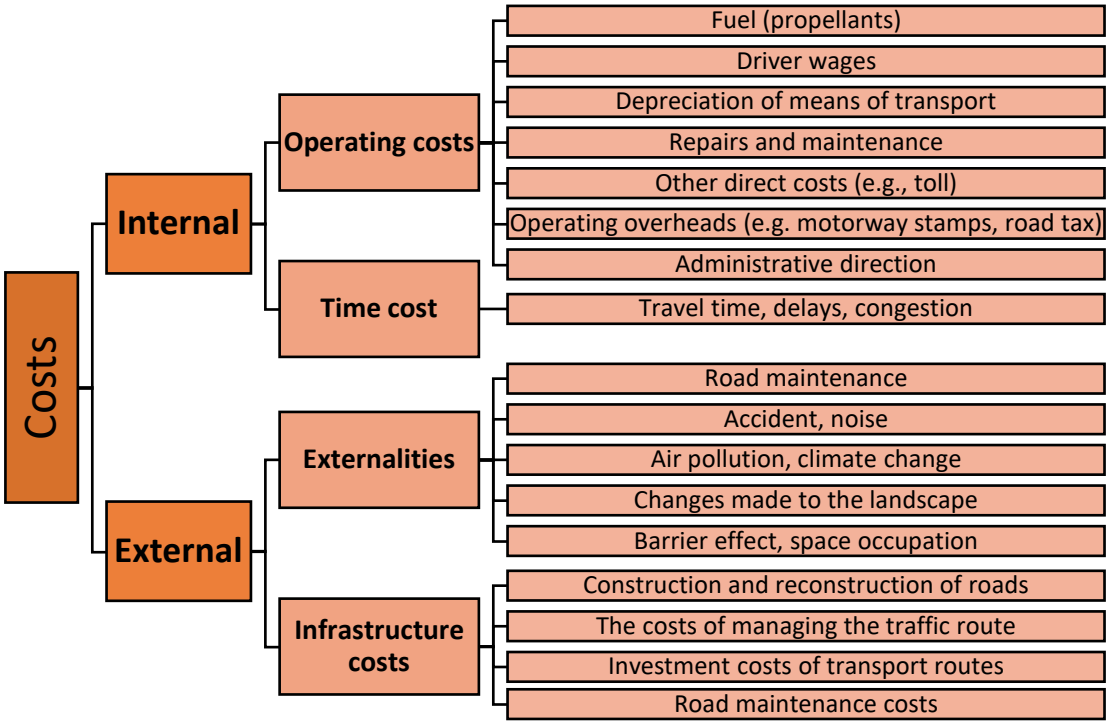
Fig. 7 Principle scheme for ordering and financing public transport in the Czech Republic



Source: Own (according to: Novotný, 2020)

It is necessary to mention the costs that occur in the field of transport. According to Chlaň and Stejskal (2008), costs are divided into internal and external, and they differ according to their bearer. Internal costs fall on transport users, administrators or transport companies, and external costs are borne by the entire society. Internal and external costs together form social costs (i.e., the amount the state is prepared to spend to meet transport needs). The overall overview of costs can be seen in Fig. 8.

Fig. 8 Cost structure of the transport system



Source: Own (according to: Faifrová & Tichý, 2012)

Investing is closely related to obtaining funds. According to the analysis of the road and railway infrastructure condition, it is evident that it is necessary to maintain existing resources and, at the same time, find new ones. The existing road and railway infrastructure is underfunded in many countries for a long time, and there is a lack of funds for adequate development (e.g. Papajohn, Cui, & Bayraktar, 2011; Zhang & Batjargal, 2022; Židová & Čamaj, 2022). Existing sources include the state budget, time and performance charges for users, road tax, share of consumption tax, EU funds and loans from the EIB (European Investment Bank). New potential sources include PPP (Public-Private Partnership), bonds or loans. The aim of the current funding sources is to change some items and increase the total income of funds. The most important point is the state budget, which must be balanced and stable in order for funding to be sustainable. It is necessary to ensure more income without limiting investment expenses, which, thanks to the multiplier and acceleration effect, have a positive effect on the national economy. The analyses show that alternative financing is widely used abroad, because the financial burden can be spread over several years (Kuchař, 2013).

The work of Kopecký (2012) points to the fact that the market shares of road and rail transport are a consequence of the needs of entities using the transport market. They are,

therefore, not correlated in any way with the amount of funds that are invested in infrastructure development and maintenance. The mentioned issue should be further addressed and this fact should be a premise in the creation of the state investment plan for transport infrastructure.

Impact of investments in public transport

According to the American Public Transportation Association (APTA, 2020), reasons for investing in public transportation include social, environmental, and economic considerations. Thanks to public transport, even people who do not own a car are well mobile, but at the same time it also brings benefits to users of car transport. It helps reduce the increase in car traffic and thus delays in congestion, impacting the quality of the environment or neighbourhood development. Investments in public transport also affect the flow of money, an area's economy and job creation. The direct benefits to passengers can be divided into three categories, all of which can provide monetary savings: travel time savings, travel cost savings and reliability improvements. Table 4 shows examples in individual categories for users and non-users of public transport.

Table 4 Direct benefits for users and non-users of public transport

	Users of public transport	Non-users of public transport
Time savings	Reduction of exit and boarding time, waiting time, driving time, elimination of the need to look for parking.	Lower delays caused by congestion (when the capacity of road facilities is exceeded, the average travel time increases exponentially - by moving passengers to mass transport, the number of cars will be reduced).
Cost savings	Reduction of vehicle operating costs (incl. fuel, parking, tolls, maintenance, depreciation), vehicle acquisition (incl. insurance, depreciation), lower price for public transport (compared to e.g., taxis).	Reduction of excessive fuel consumption caused by driving on congested road networks.
Reliability	Better information, improved dispatching, planning, quality infrastructure (e.g., dedicated lanes, right of way).	Greater reliability of vehicles due to less delay and congestion (traffic jams increase the frequency of collisions).

Source: Own (according to: APTA, 2020)

In their report, APTA (2020) further mentions the calculated financial savings from public transportation investments in America. These include, for example, savings of $11.7 billion per

year for passengers who use public transport instead of other modes of transport. Reducing traffic congestion can generate savings for businesses and households of up to $800 million per year. Labour productivity would increase by $1.2 billion per year after the expansion of the public transport service area.

In addition to the economic benefits, Dragoun (2017) also mentions the socio-economic benefits of investment projects, the basic part of which are non-market influences. These include, for example, a reduction in the rate of accidents, noise and environmental pollution, a reduction in the impact on climate change, time savings, benefits from reduced emissions, benefits from savings in road transport, residual value or incremental operating income. According to MDČR (2013), by investing in rail transport, benefits can be obtained from the external effects of transferred transport (part of road transport will be transferred to rail), such as a reduction in the external negative effects of road transport. The driving time of the vehicles depends on the distance traveled, the type of vehicle, or the profile of the track. When renewing the vehicle fleet may arise time savings, for the calculation of which it is necessary to divide the transport model into existing, transferred and induced transport (only half of which is included in the savings). In road transport, cost savings can be calculated from the costs of road repairs and maintenance, the operation and maintenance of road vehicles and based on the transport forecast of transferred traffic. Reduction of emissions can also be achieved by electrification. These effects can be evaluated financially.

3.2 Development of tourism

As stated by Gartner and Mihalič (2013), tourism development is a debatable term and is explained by many definitions that have evolved over the years. According to the authors Stiglitz, Sen and Fitoussi (2010), a holistic approach to development is important, which takes into account not only a higher rate of economic growth and GDP but also education, health, a better environment, sustainability, less poverty, freedom, equality and culturally richer and happier life. The World Bank (1991) also agrees with the importance of these aspects.

In her publication, Linderová (2015) mentions that the formation of tourism began at the turn of the 19th and 20th centuries and is now understood as a branch of social activity. In 1991, the World Tourism Organization (WTO) organized an international conference in Ottawa to unify the definition of tourism. On the basis of this conference, the UN adopted the following definition of tourism in 1993 - it is the activity of people who travel for a temporary period outside their usual environments and the main purpose of the trip is not the performance of

a gainful activity (Gúčik, 2010). As Linderová (2015) states, tourism was initially understood only as a stay, then travel, motivation, and finally, free time was added to the definitions. Bieger (2010) compiled a tourism system model that defines four basic subsystems of tourism:

1. Destination (e.g. accommodation and catering facilities, attractions, etc.)
2. Transport (e.g. local carriers, transport companies, etc.)
3. Intermediaries (e.g. travel agencies, web portals, etc.)
4. Demand (e.g. tourists and business travelers)

Tourism has the potential for economic use and development of a region in which there is an attractive primary offer (cultural or natural attractions) and a corresponding secondary offer (Gúčik, 2011). Indrová et al. (2001) agree with this, and they state that the basic assumption for the realization of tourism is the existence of some attractiveness in the given area. However, it is important to develop tourism only in such a way that it does not exceed the carrying capacity of the given destination, because then, on the contrary, the usability potential would decrease (Zelenka & Pásková, 2012). According to Kalousová and Jarábková (2015), the tourism offer includes services that have a dominant position. These are transport, accommodation and catering services. For example, the authors Orieška (2010) or Šejvlová et al. (2011) claim that it is the transport infrastructure and its quality that plays the most important role in the development of the territory and tourism, because tourism is directly dependent on it. When a new tourist destination is created, it is necessary to expand and adapt the transport network simultaneously, so there is a mutual complement between transport services and tourism. Transport also ranks among the implementation assumptions of tourism, while the sum of all assumptions constitutes the potential of tourism (Pourová, 2010; Vystoupil et al., 2011).

3.2.1 The influence of transport on the development of tourism

As already said, transport is the main assumption for the development of tourism (Rodrigue, 2020). Traveling is often confused with tourism, while it is a movement by which the subject is transported to the destination or around the final destination (Kalousová & Jarábková, 2015). According to Orieška (2010), transport services are easily available and relatively cheap. Participants in the tourism industry can use public passenger transport or individual car transport. As reported by Adamec et al. (2005), for the transfer of passengers, public transport is preferred over individual transport, as it helps to reduce the number of vehicles on the roads, and thus to reduce their negative impacts.

Studies show that shared transport also reduces the number of vehicles - one shared car can replace up to 23 individual private cars (Viegas et al., 2016; Martin et al., 2016). In shared transport, the user does not own a private vehicle, but shares the vehicle with several people, and this sharing can be private or as a commercial service. Shared transport models include carsharing, bikesharing or ridesharing, the best-known providers of shared vehicles include Uber, Bolt, Grab, BlaBlaCar, Didi, Car2Go and Lyft (Cohen & Kietzmann, 2014). As stated by Deloitte (2017), Uber, which was originally established as a car-sharing service, is one of the best-known providers of shared transport in the Czech Republic, but today it is a service similar to a classic Taxi. Shared transport responds to demand and is flexible (times, routes, etc.), unlike conventional public transport, which may have timetables adapted to tourists and not suit local residents (e.g. commuters) and vice versa (Brake et al., 2004; Enoch et al., 2004; Logan, 2007). Shared transport services have the potential to fill the gap between less accessible private transport and lower-quality public transport (Inturri et al., 2018). These authors further add that thanks to modern technologies and flexibility, this transport stands between exclusive door-to-door driving (e.g. conventional taxi) and cheaper, sustainable public transport. It can therefore be said that shared individual transport is a kind of intermediate level, as it reduces the number of cars in the city, and is thus more ecological and more affordable than taxis. On the contrary, thanks to its flexibility, the tourist can be driven directly to the attraction and does not have to look for routes and transfers. For this reason, it could also be considered beneficial for the development of tourism – research question Q5: Is public transport more beneficial for local tourism development than individual shared transport (e.g. Uber)?

Manniche, Larsen, Broegaard and Holland (2018) include shorter distances traveled, longer stays in one destination, shorter distance travel or the use of more ecological means of transport among the options for reducing the negative impacts of tourist travel. Hall (1998) and Duval (2007) draw attention to the negative effects of transport development on the destination, among others, who point to the possibility of congestion and pollution, which leads to the devaluation of the destination. It is also important to focus on the needs of the end customer of tourism to avoid a decline in the use of public transport (Gronau & Kagermeier, 2007). The task of transport is to efficiently, quickly and cheaply transport a large number of passengers. Therefore it is necessary, especially in cities, to improve public transport and expand its offer so that it is at least a comparable (if not more suitable) alternative to transport by individual passenger car (Rodrigue, 2020). Prideaux (2000) mentions that the public transport system enables the flow of arriving tourists, ensures the accessibility of tourist destinations and thus appeals to a larger

number of potential tourists. A high-quality integrated transport system has the potential to make the offer of public transport more attractive and thus facilitate movement around the destination. Gronau and Kagelmeier (2007) add that it would be advisable to ensure that passengers use public transport even in their free time. Options for public transport support for recreation can be, for example, a discount on entrance fees when purchasing a travel ticket, limiting the availability of tourism attractions using passenger cars, etc. These authors also list steps to support public transport in the tourism industry:

- Identification of the key target group in the destination.
- Ensuring the connection of various types of transport to public transport.
- Promote the offer to potential customers and service users.

Mobility is one of the factors that increase the possibility of individual choice in the evaluation of the quality of life (Nakanishi & Doi, 2003), and people who feel uncomfortable in movement evaluate their level of happiness more negatively (Delbosc et al., 2011; Sasaki, 2014). Public transport can be ranked among indicators of sustainable tourism, e.g. Castellani and Sala (2010) include the number of daily trips by public transport, Blancas, Gonzalez, Lozano-Oyola and Perez (2010) mention the importance of public transport vehicles for passengers. In their paper, Li, G., Li, B., Ju and Zhang (2017) identify five key issues along with guiding principles in the field of sustainable transport and the development of integrated urban transport planning:

- Harmony of transport and land use - principles: access, use of land and resources.
- Internal integration of the transport system – principle: integrated planning.
- Coordination of transport and nature - principles: pollution prevention, individual responsibility, health and safety.
- Coordination of transport and society - principles: more complete cost accounting, equality.

3.2.2 Modern trends in transport

The transport policy of the Ministry of Transport of the Czech Republic (MDČR, 2021) deals with automated and autonomous transport, which is now a global trend and is closely related to artificial intelligence and digitisation. An autonomous vehicle can be an automated, self-driving, or driverless car (Chong et al., 2013; Olaverri-Monreal, 2016). Autonomous electric vehicles can serve urban peripheries and offer benefits such as increased safety, improved transport availability, and reduced emissions and passenger costs. Innovations like automation

will also affect tourism, as transport is an essential part of it (Jászberényi & Munkácsy, 2018). Action Plan (2019) lists among the benefits of autonomous vehicles:

- increasing the efficiency of the transport system - smoother traffic and reducing congestion (less burden on the city),
- increasing safety in transport - currently, more than 90% of traffic accidents are accidents caused by the human factor,
- improving the availability of transport and mobility services - e.g. for disabled passengers who cannot fully drive a normal vehicle by themselves, or people without driving licence (this would make it easier for them to engage in tourism and reduce their social isolation, see also Anderson et al., 2014, or Koul and Eydgahi, 2018),
- reduction of emissions - use of alternative powered and public mass passenger transport.

Kyriakidis, Happee and de Winter (2015) or Platt (2017) include the usefulness of travel time as a benefit, as passengers can do other activities during the trip. Bansal and Kockelman (2017) or Litman (2017) mention the forecast that by 2045 autonomous vehicles should make up half of road traffic. Despite this, the academic literature discussing the impact of autonomous vehicles on the city and addressing the negative aspects is insufficient (Bagloee, Tavana, Asadi, & Oliver, 2016; Gruel & Stanford, 2016; Truong, De Gruyter, Currie, & Delbosc, 2017). Lassa (2012) states that autonomous electric vehicles are more specific because they can "perceive" the route and surrounding vehicles, but there is still a so-called moral dilemma, when in a crisis situation the vehicle is not able to decide the consequences as a human factor. In recent years, researchers have also been mainly concerned with the development of autonomous vehicles, how they change mobility patterns and their use in the urban environment (Bagloee et al., 2016; Madigan, Louw, Wilbrink, Schieben, & Merat, 2017; Tokody & Mezey, 2017). According to research, automation makes it easier to use cars, so passengers can easily switch to using cars and this can cause the decline of other modes of transport that are environmentally friendly (e.g. public transport) (Currie, 2018). Many authors (e.g. Krueger, Rashidi, & Rose, 2016; Pakusch & Bossauer, 2017; López-Lambas & Alonso, 2019; Stark, Gade, & Heinrichs, 2019; Winter et al., 2019; Iclodean, Cordos, & Varga, 2020) also focus on the possibilities of using autonomous vehicles in urban public transport, their benefits or the willingness of passengers to use these vehicles. This could lead to a balance between the development of autonomous vehicles and at the same time the development of public mass transport. The authors are also concerned with the change in the experience of driving in an autonomous vehicle, because a new and interesting

experience occurs, on the contrary, for some it is a loss of enjoyment from driving a vehicle (see Miskolczi et al., 2021). Cohen and Hopkins (2019) state that autonomous vehicles have the potential to reach new destinations so that tourists will be able to visit less frequented or more remote attractions. Bainbridge (2018) deals with the possibility of replacing conventional shuttle buses and taxi services with autonomous vehicles, while city tours (so-called AutoTours) could be introduced, which would work on the principle of hop on - hop off buses. This service could be more flexible and the route could be planned according to tourists' preferences in real time. The behavior of tourists may change due to automation, for example, urban nightlife and parties may become more attractive as tourists will be able to drink alcohol, which may reduce the responsible attitude of visitors (Bainbridge, 2018). Based on a research investigation, Miskolczi et al. (2021) concluded that tourists have a positive attitude towards the introduction of autonomous vehicles into the tourism industry, while they find sightseeing opportunities very attractive. Travelers cite a better tourist experience and observation of the environment as a benefit. A related topic is smart cities and intelligent transport systems that connect information, increase the safety and flow of traffic and also the efficiency of the transport process (MDČR, 2021). As stated by Kim, Moom and Suh (2015), the concept of smart urban mobility integrates intelligent and sustainable transportation technologies and cooperative intelligent transportation systems through cloud servers. Thus, smart mobility combines urban transport services with smart technologies (Chun & Lee, 2015).

Another topic may be the restriction of internal combustion engines and the introduction of alternative fuels. The government has discussed a ban on the sale of new vehicles with an internal combustion engine after 2035 and the introduction of the Euro 7 standard, with a final vote postponed for now. Both the Czech Republic and Germany see this as a threat to the automotive industry, which is not ready for this radical change, so the Czech Republic wants to negotiate at least an exception for the use of so-called synthetic fuels (Kupka, 2023). As Indráček says (Rok, 2023), it is necessary to stop lying to ourselves that electromobility is emission-free, because it is necessary to evaluate the entire life cycle of the fuel and not just the final emissions during driving. Professor Thomas Koch (in Plachý, 2023) from the Institute of Technology in Karlsruhe (Germany) claims that this is a political decision to limit individual mobility, not nature protection. He also states that, according to energy experts, CO_2 emissions will not decrease in some countries, but on the contrary, with the rapid expansion of electromobility, they will increase. The end of production of internal combustion engine cars will affect many suppliers and car manufacturers, and suppliers will take over their positions

from China. Banning the sale of vehicles with an internal combustion engine will have a negative impact on people with lower incomes, as individual mobility will become more and more expensive and less accessible for them (Koch in Plachý, 2023). The question here is how mobility will further develop and how it will affect tourism. Synthetic fuel will be expensive and passenger cars will become less affordable. It is, therefore, possible that passengers will have to limit their travel and some tourism destinations will decline (not the entire area is served by public transport). There is the possibility of greater use of public transport and the development of alternative modes of transport (bikesharing, etc.).

4 Summary of identified gaps

There are several factors that can motivate passengers to choose public transport. These can include, for example, price and speed of transportation, reliability, timeliness, fluidity, convenience, quality reservation system or previous experience (Hensher, Stopher, & Bullock, 2003; Beirão & Cabral, 2007; Kunhart, 2008; Tyrinopoulos & Antoniou, 2020 ; Soza-Parr, Raveau, & Muñoz, 2022). Here it is possible to determine the most motivating factor for passengers. Another area for investigation may be the relationship between gross household income and household expenditure on transport, which also includes expenditure on mass transport. Pojkarová (2007) claims that there is a dependency here, but it is possible to deal with this further and solve the possibilities of choice of users with different incomes. Ecology is a much discussed topic and the goal is to make users be pro-environmental. Nilsson and Küller (2000) mention that the environmental aspect is not important for commuters because they prioritize comfort and personal needs in their daily travel. It is therefore appropriate to verify this statement, to find out which groups of passengers pay less attention to ecology and why, and subsequently to propose options for making public transport more attractive to them. This may also be related to the use of different types of transport depending on gender. For example, alternative modes of transport are more often used by women, therefore it is important to convince men to use less individual transport (MDČR, 2021). Many authors (e.g. Brake et al., 2004; Enoch et al., 2004; Logan, 2007; Viegas et al., 2016; Martin et al., 2016; Inturri et al., 2018) deal with shared transport, which they consider it suitable as filling the gap between less accessible private transport and ecological public transport. Shared transport is thus more environmentally friendly than a private car and at the same time more flexible than mass public transport. It is therefore appropriate to assess its contribution to the development of tourism.

Based on the systematic literature research, research gaps were identified, and the following research questions were formulated:

- Q1: What would motivate travellers to use ITS more?
- Q2: Is the household income related to their transport expenditure?
- Q3: Do workers look out for the environment or prefer greater comfort in their daily journeys?
- Q4: Does the use of alternative modes of transport depend on the gender of the passenger?
- Q5: Is public transport more beneficial for local tourism development than individual shared transport (e.g. Uber)?

5 Methods

5.1 Research sample

The results of a questionnaire survey with tourism experts were used for the empirical part. Experts (experts from practice and academics) in the field of tourism were asked "What benefit do the following services have, from your point of view, for local development?", which related to the influence of the selected modes of transport for tourism.

Data collection took place in the state of Mexico in the period 18.09.-03.11.2021, specifically in the cities of Zamora, Guadalajara, Cancún, Mérida and Mexico City. Out of the total number of 40 contacts, 23 questionnaires were received from tourism experts. Furthermore, data collection was carried out in other selected EU states in the period 01.04.2022-31.10.2022, specifically in the Netherlands (Amsterdam and Rotterdam), Italy (Rome and Milan), Germany (Berlin and Munich) and Austria (Vienna and Linz). Subsequently, data were collected from experts in the Czech Republic. In each country, there were approached 40 respondents, while the number of questionnaires received was: Netherlands 21, Italy 17, Germany 18, Austria 22 and the Czech Republic 20. The experts were contacted by email before the field research, then in person during the survey and then again using the obtained contacts after our return to the Czech Republic. The total number of responses received from tourism experts from the selected countries was 121.

5.2 Statistical data processing

The presented statistical analysis is based on the answers to the question “What benefit do the following services have, from your point of view, for local development?“ There was a choice

of four transport services – Public Transport, Uber, Taxi and Car Rental. This question was chosen to monitor the set problem area, specifically the importance of different types of transport for local development.

First, basic statistics were performed for the obtained data. Differences between sub-factor levels of individual dependent variables with the country explanatory factor were tested by factorial ANOVA with repeated measures. The answers to the selected factors in a specific variable are dependent (the expert expresses his opinion on the importance of different types of transport, which are four), so one of the assumptions for classical ANOVA is violated, and for that reason, factorial RM ANOVA was used. Finally, a Tukey HSD post-hoc test for unequal n was performed.

Independent variables were measured on a scale of 1-5, using a numerical Likert scale (1 = least and 5 = most). Specifically, 1 = the least contribution of a specific mode of transport to local development and 5 = the greatest contribution of a specific mode of transport to local development. An odd number of options was chosen for the neutral attitude option (No. 3), the negative attitude is toward No. 1, and the positive attitude toward No. 5. The STATISTICA 12 program, StatSoft, Inc. 1984-2013, was used for statistical data processing.

Another method used was the calculation of the Pearson correlation coefficient quantifying the correlation between the gross monetary expenditure on transport and the average gross monthly wage. Data from transport yearbooks and the Czech Statistical Office for the available years 2000-2016 were used. The calculation was made according to the general formula:

$$r = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{(n-1)s_x s_y} \quad (3)$$

6 Results

6.1 Descriptive statistics

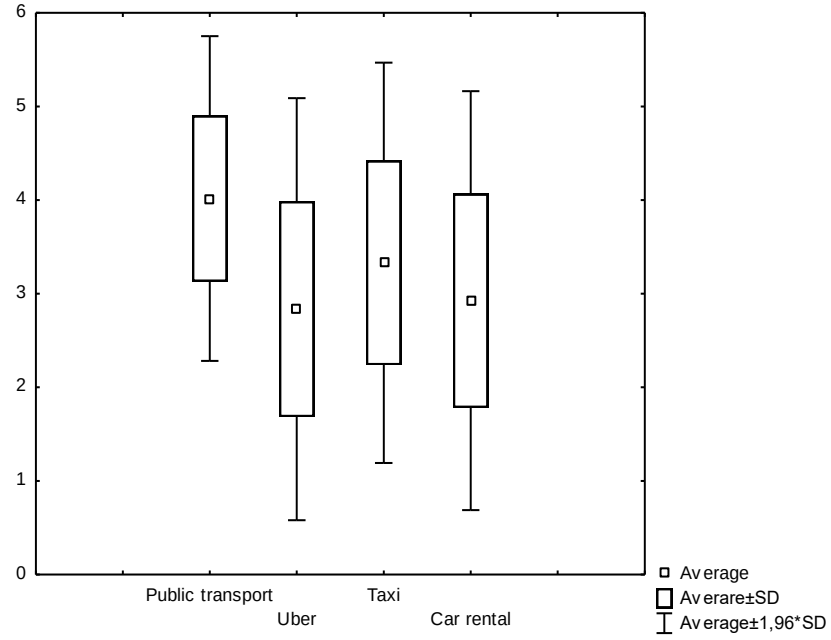
To summarize and better present the data, basic descriptive statistics were used (Table 5). The number of responses for each variable is 121, and there are 4 variables - Public transport, Uber, Taxi and Car rental. For all variables, the minimum value is 1 and the maximum value is 5. The averages of the response values can then be seen in the box graph (Fig. 8).

Table 5 Basic descriptive statistics

Variable	Descriptive statistics				
	N valid	Average	Minimum	Maximum	SD
Public transport	121	4.016529	1.000000	5.000000	0.884906
Uber	121	2.834711	1.000000	5.000000	1.149979
Taxi	121	3.330579	1.000000	5.000000	1.090783
Car rental	121	2.925620	1.000000	5.000000	1.141383

Source: Own research

Fig. 8 Box plot for response means



Source: Own research

6.2 Importance of different types of transport in the destination

There is an opportunity to test three basic types of null hypotheses (the first null hypothesis H_{01} was chosen for this article):

- H_{01} – There is no significant difference between the groups of the first factor – public transport, Uber, taxi and car rental (repeated measures) in relation to the dependent variable.
- H_{02} – There is no significant difference between the groups of the second factor – state in relation to the dependent variable.
- H_{03} – There is no interaction between the factor public transport, Uber, taxi and car rental and the factor state.

Alternative hypotheses are:

- H_{11} – There is a significant difference between the groups of the first factor – public transport, Uber, taxi and car rental (repeat measurement) in relation to the dependent variable.
- H_{12} – There is a significant difference between the groups of the second factor – the state in relation to the dependent variable.
- H_{13} – There is an interaction effect between the factor public transport, Uber, taxi and car rental and the factor state.

From the results of the RM ANOVA statistical method, it was found that the importance of different modes of transport for local development is different between modes of transport and different modes of transport have different development potential in individual countries. In addition, a large difference was found in the overall importance of transport for destination development. Table 6 shows the results of ANOVA with repeated measurements.

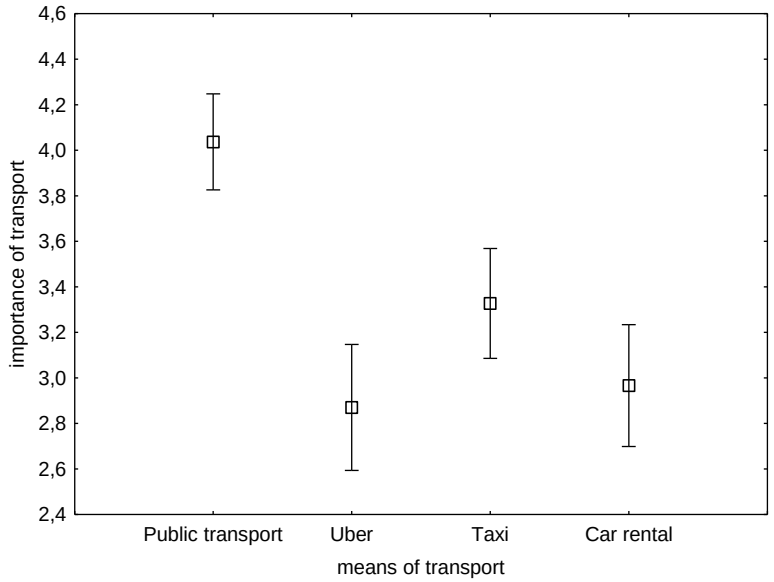
Table 6 ANOVA with repeated measurments

Effect	Repeated Measures Analysis of Variance; Sigma-restricted parameterization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Abs. mem.	5126.348	1	5126.348	1764.157	0.000000
State	26.730	5	5.346	1.840	0.110532
Error	334.171	115	2.906		
MODE	105.455	3	35.152	72.638	0.000000
MODE*State	23.913	15	1.594	3.294	0.000036
Error	166.954	345	0.484		

Source: Own research

Public transport is perceived as the most important developing mode of transport, followed by taxis and the least important modes of transport are Uber and car rental. It can therefore be said that regardless of the state, public transport is perceived more beneficial for development than Uber (see Fig. 9).

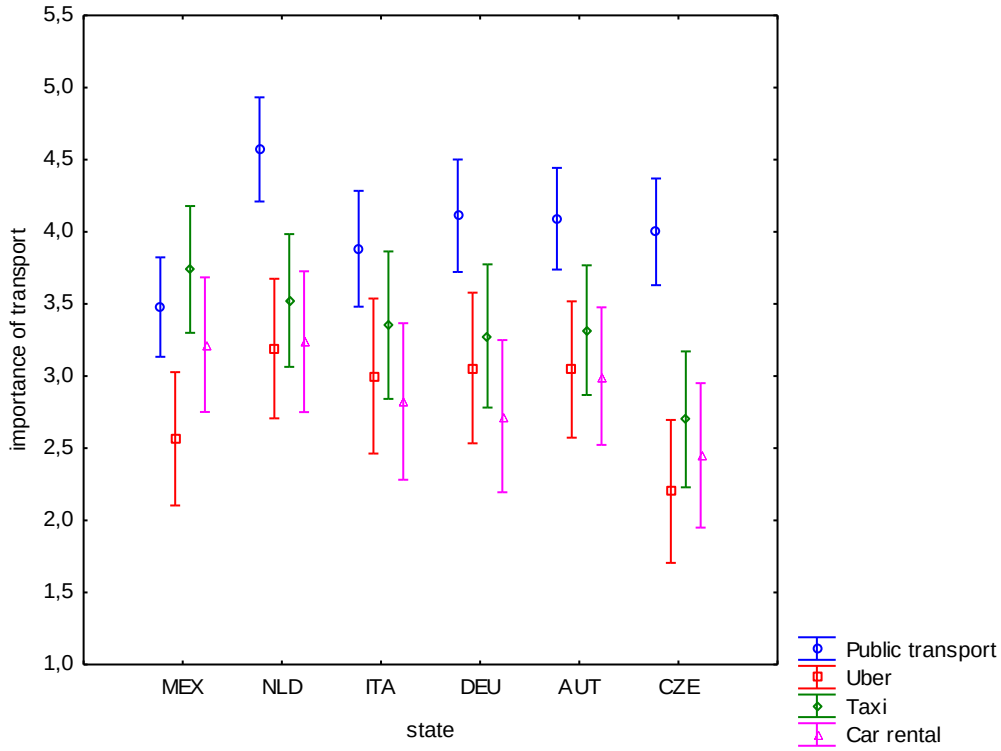
Fig. 9 RM ANOVA for all modes of transport



Source: Own research

However, the importance of individual types of transport differs in specific countries (see Fig. 10). In the State of Mexico, the importance of public transport is suppressed, on the contrary, the importance of taxis is strengthened (they have almost identical average values). In the Czech Republic, the importance of all types of transport except public transport is considerably smaller than in other countries. In Italy, all four modes of transport are considered equally beneficial for local development. Therefore, at a significance level of 5%, the alternative hypothesis H_{01} can be accepted: There is a significant difference between the groups of the first factor - public transport, Uber, taxi and car rental (repeat measurement) in relation to the dependent variable.

Fig. 10 RM ANOVA for all modes of transport by state



Source: Own research

From this analysis, a significant effect of MODE and MODE*State factors can be seen, but the test does not tell which modes are significantly different from others. It is, therefore, necessary to perform subsequent post-hoc tests. For testing was chosen the null hypothesis H_0: The benefit of public transport for the local development of a given destination does not differ from the benefit of Uber (PT = Uber). The country is an explanatory factor. The alternative hypothesis is, therefore, H_1: The benefit of public transport for the local development of a given destination differs from the benefit of Uber (PT ≠ Uber). We will test this hypothesis using the Tukey HSD post-hoc test for unequal N. As can be seen in Table 7, according to the results of this test, it turned out that all modes of transport are significantly different from each other, at the significance level of 5% Uber and car rental are not different.

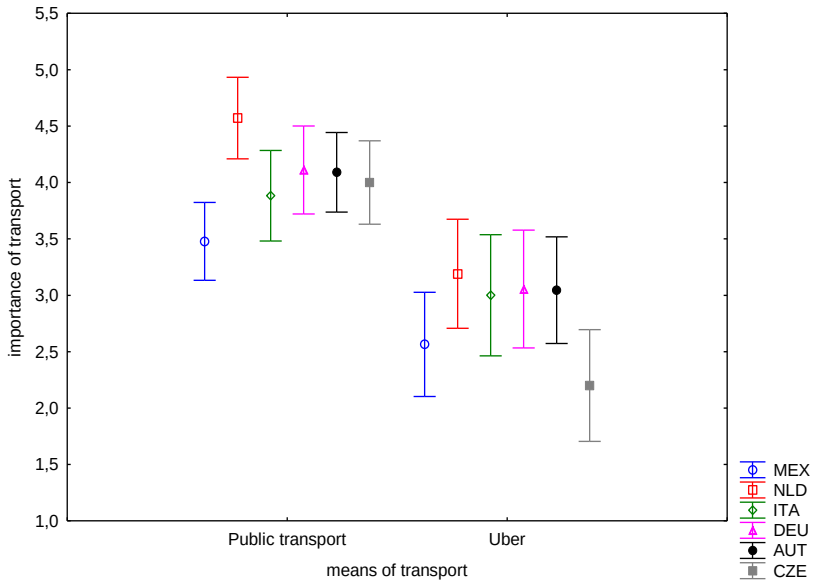
Table 7 Tukey HSD for unequal N

Nr.	HSD at unequal N; Approximate Probabilities for Post Hoc Tests Error: Internal MS = .48393, Degr. of Freedom = 345.00				
	MODE	{1} 4.0165	{2} 2.8347	{3} 3.3306	{4} 2.9256
1	Public transport		0.000008	0.000008	0.000008
2	Uber	0.000008		0.000008	0.739793
3	Taxi	0.000008	0.000008		0.000042
4	Car rental	0.000008	0.739793	0.000042	

Source: Own research

As it emerged from the results of RM ANOVA, public transport is more important than Uber in all states (Fig. 11). Table 8 then shows the average ratings of these two variables depending on the individual states. The averages show that the largest difference between the observed variables is in the Czech Republic, while the two modes of transport differ least in Mexico. At a significance level of 5%, the alternative hypothesis H_1 can be accepted: The benefit of public transport for the local development of a given destination differs from the benefit of Uber. From the Tukey HSD Post-hoc test for unequal N, it was found that the significance of public transport and Uber differ at the 5% significance level in all the selected states, only not in Italy, as the resulting value was 0.055278.

Fig. 11 RM ANOVA for Public transport and Uber by state



Source: Own research

Table 8 Rating averages in individual states

Tate	Public transport	Uber	Difference
Mexico	3.4783	2.6667	**0.8116**
Netherlands	4.5714	3.1905	1.3809
Italy	3.8824	3	0.8824
Germany	4.1111	3.0556	1.0555
Austria	4.0909	3.0455	1.0454
CZ	4	2.2	**1.8**

Source: Own research

6.3 Relationship between household income and household expenditure on transport

The values of gross money spent on transport and average gross monthly wages in the Czech Republic are still growing, and their values in the years 2000-2016 can be seen in Table 9.

Table 9 Transport expenditure and household income

Year	Gross monetary expenditure on transport - averages per capita per year (CZK)	Average gross monthly salary (CZK)	Year	Gross monetary expenditure on transport - averages per capita per year (CZK)	Average gross monthly salary (CZK)
2000	7 774	13 219	**2009**	12 105	23 344
2001	8 558	14 378	**2010**	12 409	23 864
2002	8 028	15 524	**2011**	12 889	24 455
2003	9 038	16 430	**2012**	12 732	25 067
2004	9 586	17 466	**2013**	13 240	25 035
2005	10 132	18 344	**2014**	12 805	25 768
2006	10 648	19 546	**2015**	12 803	26 591
2007	11 189	20 957	**2016**	13 896	27 764
2008	12 421	22 592			

Source: Own (according to: transport yearbooks and the Czech Statistical Office)

From the sample Pearson correlation coefficient calculation quantifying the correlation between the gross monetary expenditure on transport and the average gross monthly salary, a strong direct dependence can be seen, as its value came out to be 0.98.

$$r = \frac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{(n-1)s_x s_y} = \frac{4176188631 - 4032736884}{(17-1)*1985.09*4589.41} = \frac{143451747}{145766270.35} = 0.98 \quad (4)$$

7 Discussion

The empirical part of the paper looked for answers to the research questions Q2 and Q5. The Q2 question concerns the relationship between household incomes and their expenses on transport. By calculating the Pearson correlation coefficient, which came out to be 0.98, it was found that there is a strong direct relationship between these variables. This result is in accordance with findings of Pojkarová (2007). People with higher incomes, therefore, spend more money on transport. Already the authors of Meyer, Kain and Wohl (1965) and LeRoy and Sonstelie (1983) claim that passengers choose the mode of transport according to the amount of income, and that private cars are unattractive for poorer people due to high costs. For these people, public transport is more acceptable, but it is more time-consuming. Edwards (2011) characterizes 21st-century mobility as people traveling much more and further, rich people traveling more than poor people and poor people using public transport and buses more. Here, it would be appropriate to further consider whether people with higher incomes prefer more expensive but more comfortable individual car transport or prefer more trips using cheaper public transport.

The Q5 relates to the benefits of individual types of transport (specifically public transport, Uber, taxi and car rental) for local development. The RM ANOVA statistical method was used to process the results of a foreign questionnaire survey for tourism experts. Basic statistics of the selected data were processed in the first step for a better overview and orientation in the collected 121 responses. After performing RM ANOVA was accepted the alternative hypothesis H_{11} – there is a significant difference between the groups of the first factor – public transport, Uber, taxi and car rental (repeated measurement) in relation to the dependent variable. Furthermore, it was necessary to use a Post-hoc test to determine between which modes of transport this difference was. According to the results of the Tukey HSD post-hoc test for unequal N, it can be said that all modes of transport are significantly different from each other, and at the 5% significance level, Uber and the car rental company do not differ. As revealed by the results of the RM ANOVA, the benefit of public transport to the local development of a given destination differs from the benefit of Uber and the importance of public transport exceeds the importance of Uber in all states. From the averages, it can be seen that the biggest difference between the monitored variables is in the Czech Republic, while these two modes of transport differ the least in Mexico.

Although the authors such for instance Brake et al. (2004), Enoch et al. (2004) or Logan (2007) highlight the flexibility of shared transport compared to classic public transport, the results of a questionnaire survey for tourism experts show that public mass transport is rated in all countries as more beneficial for the development of tourism. Adamec et al. (2005) agree with this, they claim that it is preferable to transport passengers by public transport and thus reduce the negative impacts of passenger cars. As stated by Le-Klähn, Hall and Gerike (2014), public transport plays an important role in the development of urban tourism as well as sustainable mobility. Other authors (e.g. Mrníková, Poliak, Šimurková, & Reuter, 2018) also see high-quality public transport as a great benefit for the development of tourism. The averages of the experts' responses show that the smallest difference in the perception of the benefits of public transport and Uber is in Mexico. This may be caused by the lower quality of public transport there, which, according to Dodero (2013), is also caused by the fact that it is provided by a large number of small private companies, unregulated private providers or individual concessionaires. The biggest difference in averages is in the Czech Republic, where Uber's contribution is rated the worst, although on 30.4.2018 the government of the Czech Republic, the company Uber and the capital of Prague concluded a memorandum of understanding on the provision of transport services in the territory of the Czech Republic (Memorandum, 2018) - that is a kind of agreement on the state's willingness to cooperate.

Deloitte (2017) states that Uber is a similar service to a classic taxi. Inturri et al. (2018) add that shared transport could stand between public transport and conventional taxis. However, the obtained results showed that experts perceive classic taxi as more beneficial than Uber. Here is a space for investigation why Uber is not perceived so much beneficially, although as Stone (2019) states, it is cheaper than a classic taxi and its advantage is also the use of the application. On the other hand, Wymanová (2017) counters that not all people own a smartphone or a payment card (of course, the penetration rate varies from country to country), so Uber should not displace classic taxi services.

8 Conclusions

The aim of the paper was to explore the current knowledge in the field of the integrated passenger transport system (IPTS) in the context of the tourism development, identify the unanswered questions that require further research and assess some elements of the IPTS development potential. The paper further studied the experts' opinions on the importance of public transport in tourism compared to the potential of the shared individual transport.

Since transport is one of the most important development elements in tourism, it is necessary to deal with it and improve its quality. Experts strive for the most efficient and, at the same time, the most ecological transport options around the destination, so it is advisable to focus on improving the quality of public transport and the possibilities and benefits of ITS. As found, public mass transport is considered by tourism experts to be the most beneficial for development in all the countries under review. Furthermore, a strong direct relationship between gross household income and household expenditure on transport, which also includes expenditure on mass transport, was confirmed. This issue could be further investigated to make it clear whether travelers with a higher income would rather choose a more expensive transport option, longer journeys, or more cheaper journeys.

Further research should follow the topics revealed by questions Q1, Q3 and Q4, meaning to study the motivations of travellers to use the services of the integrated transport system, the attitudes of commuting workers to the pro-environmental aspects of using the ITS or the sociodemographic aspects of preference to the alternative mode of transport. Researchers should also focus on the integration of individual and mass transport, especially P+R parking, further on transport options in tourism, negative impacts of transport on tourism destinations, and the importance of integrated management of passenger transport in the tourism industry.

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