

Research Article

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Service quality of the urban public transport companies and sustainable city logistics

<https://doi.org/10.1515/eng-2020-0010>

Received Oct 30, 2019; accepted Jan 29, 2020

Abstract: The issue of sustainable city logistics has steadily been developed over the last decades. Urban public transport companies can make a significant contribution to the concept of sustainable city logistics. The customers' perception and satisfaction regarding urban public transport companies can be associated with the increased use of their services. The preference for urban public transport reduces the use of individual car transport, which is linked to the environmental pillar of sustainability. For the customers, the level of the provided service is very important. The article is focused on the evaluation of the outcomes from the primary research concerning the service quality performed by the urban public transport companies in the Hradec-Pardubice residential agglomeration. The goal lies in identifying gaps in service quality. The method used in this article is representative primary research. The primary research was carried out in the form of structured personal interviews with a representative sample of respondents. Selected statistical methods were used to evaluate the data. The results are discussed in the context of published research studies. Research in this article found that respondents are more satisfied with the quality of services performed by the urban public transport companies, but the perception of individual service quality factors varies from one user group to another. The research also confirms a different perceptions regarding customer care and comfort by different age groups of respondents. The article implies that public transport companies should pay attention to setting fare prices for different groups of passengers.

Keywords: sustainable city logistics, passenger transport, urban public transport, public transport company, public transportation service quality

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1 Introduction

Changes in the business environment and population growth have also implied a change in mobility requirements during the 20th century. At that time, people stopped moving only within their settlements or individual urban agglomerations and regions, but mobility moved both into the framework of the continents and also grew their intercontinental overlap. Gradually, there is an increase in performance in passenger and freight transport. There is growing pressure on the transport systems and the logistics of cities and urban agglomerations. These trends are also significant for the 21st century when it is also possible to talk about a fundamental development of modern information and communication technologies, changes in the customers' purchasing behavior, and people's changing mobility needs.

The increase in individual car traffic in cities and urban agglomerations causes a decreased driving speed, irregular urban public transport services and, as a consequence for passengers, worrying time delays [1]. There are many scientific articles illustrating the impact of globaliza-

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tion, the growth of urbanization, and the excess of individual car usage on environmental, economic and social aspects of urban life [2, 3]. The increase in individual car traffic also implies troubles associated with road infrastructure safety, air pollution growth, traffic noise, global warming, etc.; the construction of new road infrastructure and necessary transport devices requires major financial resources and covers big landscape areas; parked cars tend to be a barrier for pedestrians, cyclists and the people with disabilities [1].

Hart [4] presented the way in which the main challenges for rapid global urbanization have been aligning business, the earth, and humanity. Birkin and Polesie [5] noted that it must be based not only on producing an economic impact, but also on adopting behaviors' and practices that are socially and environmentally robust. Today, the greatest challenge for cities, urban areas and the global environment lies not only in reducing global warming, pollution and emissions levels, but also in improving the quality of life for citizens [6]. Traffic contributes to urban sprawl and also to the decentralization of towns; however, promoting sustainable transport modes is important, because city dwellers can choose among these sustainable transport modes [1].

This article deals with the issue of the quality of service performed by the urban public transport companies in the selected urban region from the perspective of sustainable city logistics. The aim of the article is to evaluate the quality of service performed by the urban public transport companies in this region, and to identify some gaps in this area from the perspective of sustainable city logistics.

The paper is organized as follows: section 1 provides an introduction to the problem and explains the reasons for the research work presented in this paper. Section 2 describes the theoretical background in the field of city logistics problems and public transport services. Section 3 describes the methods applied to the research work used for data collection and data analysis. Section 4 provides the description and comments of the research. Section 5 discusses the results and makes a comparison between the results achieved and existing research in the literature. The paper concludes with ideas for possible application in sustainable city logistics.

2 Theoretical background

Cities must find solutions for limited resources and insufficient infrastructure capacity [7]. Kauf [8] identifies city logistics as a strategic area for sustainable urban develop-

ment and uses the term "sustainable city logistics". Most authors consider achieving sustainable urban transport as a prerequisite for realizing the concept of sustainable city logistics [9]. Other authors emphasize that the optimization of intra-city transport can contribute to the sustainability and viability of the agglomeration, as well as alleviate infrastructure congestion and reduce emissions and noise [10]. Currently, the issue of sustainable city logistics is examined in many research areas. Authors find new challenges and opportunities for city logistics in the use of new sources of information to ensure sustainable transport systems in cities and urban agglomerations [11]. Other sources promote the use of big data for more detailed analysis in planning and optimizing sustainable city logistics [12–15]. Other authors emphasize the use of decision support systems and tools in solving city logistics problems because without them, it is impossible to reach an optimal solution [16–18]. Urbanization and e-commerce are two fast-rising trends that make city logistics solutions even more challenging [19]. E-commerce is considered one of the main challenges of today's city logistics, as it significantly affects the transport network within the agglomeration [20–22]. On the other hand, selecting a best rating system for developing a city in a sustainable manner is a goal for city planners [23]. Public spaces in cities and social relations are inextricably linked and interact with each other. Based on this relation, social action is shaped by the spaces in cities [24]. Developing countries have high regard for the development of cities and protecting water quality, because water quality is very significant to sustainable social-economic development of the countries [25].

Many authors have identified a large number of different approaches to ensure sustainable city logistics: increased use of energy-saving technologies, such as low-energy and low-emission vehicles, for last-mile distribution [26–28]; a higher share of co-modal transport in the total transport performance realized by all modes of transport [29, 30]; charging for the use of roads, or entrances to city centers, or to specific zones [17, 31, 32]; improving the quality and throughput of transport infrastructure and reducing vehicle emissions [33, 34]; mobility management and sustainable travel behavior [35]. Stopka *et al.* [1] stressed that some cars restrictions and good circumstances for implementation of environmentally friendly modes of transport need to be considered, because these solutions and their powerful propagation can cause urban public transport and cycling, as well as pedestrian traffic, to be more competitive and preferred over individual car transport. Urban public transport services, walking and cycling are the key elements for sustainable and resilient cities and cities for people [36–39]. Thus, in this context,

urban public transport systems and services have a crucial role in pursuing sustainable development in our societies and sustainable logistics systems [6, 8]. To improve sustainability, public transport companies can adopt several managerial practices. This among the service system provided represent an interesting solution that enable the establishment of new partnership and value network recon-figurations able to improve efficiency [40–42].

Public transport services address sustainable challenges to integrating environmental “eco-efficiency” and social sustainability with the inclusion of all stakeholders to provide better service and efficiency. In the context of public transportation services it is crucial to persuade customers to use public transport services with their environmental friendliness [6]. One possible solution to these problems lies in improving the quality of public transport services and to respect user requirements, but this can be achieved only by improving the functioning of the entire transport system [43]. Several studies agree on the fact that public transport systems in the agglomeration context can be viewed as a dynamic system [44–46]. Nevertheless, currently, the actual challenge lies in breaking the norm of using individual car transport, and one solution is represented by switching from private cars to alternative sustainable means of transportation, such as urban public transport or car-sharing [47]. As mentioned by Chen and Chao [48], the transport mode choice is determined by several factors, such as contextual factors (*e.g.* available travel modes environment), an individual’s abilities and constraints (*e.g.* car ownership), and various psychological factors (*e.g.* evaluations and motives) [49, 50]. The service quality of the public transportation system is a largely discussed issue because the achievement of sustainable city logistics is conditioned upon the high quality of the services provided by the public transport companies in the agglomeration [49, 50].

Parasuraman *et al.* [51] defined service quality as involving two aspects, namely expectation and perception. Sebhatu [52] and Enquist *et al.* [50] added that service quality can be understood as the gap between customers’ expectation and their perception that occurs during the service process, which is part of the exchange and sustainable service business. Edvardsson [53] stressed the need for customer orientation, but this does not mean that the provider must fulfill the customer’s needs, because the expectation is something that relates to what the customer wants to be served by the provider in a sustainable manner [50]. The quality of public transport services in passenger transport can be defined as a set of intangible variables, which can be assessed by four different approaches [54, 55]:

- The user’s point of view – according to research on passengers’ perceived quality, passengers mostly appreciate total time, comfort and cleanliness, accessibility of the service, accessibility of the information, service organization, safety, the behavior of transport company employees and conductors, and their costs, *i.e.* the fare [56–59].
- The operational efficiency – the assessment of technical-economic indicators describing the transport processes, including the assessment of indicators describing the work [54].
- The operation economics – business point of view performed by the carrier responsible for operation [60].
- The efficiency of usage of allocated resources by the responsible public authorities in charge of public transportation services – it is the point of view of the territorial administrative organs (municipalities, regions, Ministry of Transport) in the Czech Republic [55, 61].

The European Committee for Standardization issued the standard EN 13816, which was transposed into the Czech standard ČSN EN 13816 and specifies the requirements for definition, aims and measurement of public passenger transportation services. The main aim of this standard is to support the qualitative approach in public transportation services and to focus on the needs and expectations of the customers by using defined procedure specification. EN 13816 defines a set of recommended criteria to measure the quality of public transport services; these are divided into eight categories [62]:

- Availability – the extent of provided services in terms of geography, time and frequency.
- Accessibility – access to the public transportation system including the connection between different transport modes.
- Information – systematic presenting of information and observations about the public passenger transportation system that help to plan and realize the journeys.
- Time – all time aspects important for planning and realizing journeys.
- Customer care – the service elements introduced in order to harmonize individual customer requirements and provided service standard.
- Comfort – the service elements introduced in order to make the public transport services usage comfortable and pleasant to passengers.

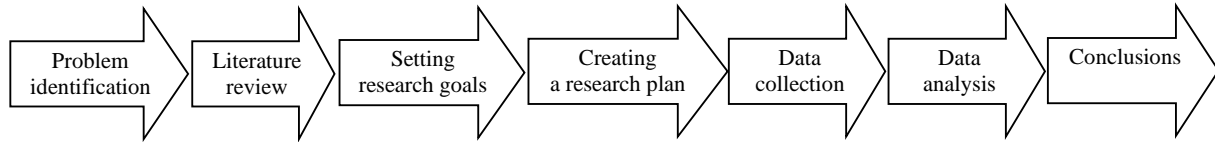


Figure 1: Research methodology.

- Safety – the feeling of personal safety truly perceived by passengers that arising from actual established measures and activities.
- Ecological impact – the minimization of a negative impact on the environment.

Other authors examined selected variables that are considered important in describing the service quality and orienting users' preferences in public transport, e.g. comfort, cleanliness [63]; line routing [64]; information about routes [63, 65]; circulation of vehicles [66, 67]; the overall condition of the vehicles and stops, security [65, 68]; optimizing timetables [69]; the availability of space and seats [63]; network coverage, the competence and behavior of staff, and time efficiency [70]. Beirão and Sarsfield Cabral [71] stated that the usage of public transport also depends on the distance to be covered, lifestyle and personal characteristics.

3 Methods

This article is focused on evaluating the quality of service performed by the urban public transport companies in the Hradec-Pardubice agglomeration and in the identification of some gaps in this area from the perspective of sustainable city logistics. The research methodology is presented in Figure 1.

The Hradec-Pardubice residential agglomeration has a polycentric character. The agglomeration is a highly urbanized area with more than 335,000 inhabitants on the border of Hradec Králové and Pardubice regions [72]. The Hradec-Pardubice residential agglomeration covers an area of 1,320 km². The agglomeration consists of two important regional cities, Pardubice and Hradec Králové, each with about 90,000 inhabitants. These cities are served by two urban public transport companies: *Dopravní podnik města Pardubic, a.s.* [Pardubice Public Transport Company] (hereinafter UPTC-P) in Pardubice [73] and *Dopravní podnik města Hradce Králové, a.s.* [Hradec Králové Public Transport Company] (hereinafter UPTC-HK) in Hradec Králové [74]. UPTC-P and UPTC-HK operate trol-

leybus and bus transport services in the Hradec-Pardubice residential agglomeration.

As can be seen in the literature review, it has been shown that sustainable city logistics is also based on the use of public transport services that are provided by the urban public transport companies, specifically in the Hradec-Pardubice residential agglomeration. These services are provided by UPTC-P and UPTC-HK. The quality of services provided by the urban public transport companies is one of the factors influencing the rate of use of these services; therefore it is necessary to focus on the quality of services provided from the perspective of all stakeholders. There are many factors influencing the quality of transport services provided, as stated in the literature review. Selected factors, defined in EN 13816 and which was transposed into the Czech standard ČSN EN 13816, were chosen for the primary research. These were: availability, accessibility, information, customer care and comfort.

The methodology of the representative primary research is based on Kozel [75] and Hague [76]. Kozel [75] defines the formula to set the right extent of the selected sample (Formula 1). In this formula n is the minimum amount of respondents, z is the coefficient of reliability (when set as 1 the statement probability is at least 68.3%, when set as 2 the probability of 95.4% is ensured and when z set as 3 the probability reaches at least 99.7%); p and q are the number of respondents that are familiar with the issue (expressed in percent). When the values of p and q are not known exactly, the maximum product is used, i.e. $p = 0.5$ and $q = 0.5$; Δ is the set maximum acceptable incorrectness (5% corresponds to $\Delta = 0.05$):

$$n \geq (z^2 \cdot p \cdot q) / \Delta^2 [-]. \quad (1)$$

Substituting into Formula 1, we obtain Formula 2:

$$n \geq (2^2 \cdot 0.5 \cdot 0.5) / 0.05^2 [-]. \quad (2)$$

If expected with the probability of 95.4%, the maximum acceptable incorrectness (5%) and maximum values of p and q , the minimum number of respondents is counted (Formula 3):

$$n \geq 400 [-]. \quad (3)$$

The number of 400 respondents is used as a standard for representative primary research in various areas of scientific interest. For example, the following authors used this number of respondents in their research: Economou *et al.* [77], Girish and Lee [78] and Kirby and El Hadidi [79].

The primary research was realized from 1 May 2019 until 31 May 2019. All the included respondents met the condition that they are UPTC-P or UPTC-HK passengers and they live in the Hradec-Pardubice residential agglomeration. Respondents consisted of people from 15 to 90 years old. The representative sample consisted of 400 respondents (203 women and 197 men). For evaluation of the quality of service performed by both UPTC-P and UPTC-HK therefore, a total of 800 respondents participating in the research were distributed into age groups according to initial population (230 people aged 15 to 24 years, 132 people aged 25 to 34 years, 160 people aged 35 to 44 years, 128 people aged 45 to 54 years and 150 people aged 55 to 90 years). Structured interviews with the following questions for each entity (UPTC-P and UPTC-HK) were selected for data collection:

- What is your gender? Possible answers: men or women.
- How old are you? Possible answers: 15 to 90 years.
- Evaluate the accessibility of services in terms of price.
- Evaluate the provided information.
- Evaluate the service availability.
- Evaluate the customer care.
- Evaluate the vehicle comfort.

Possible answers for the five selected factors were as follows: quite sufficient (evaluation 1), rather sufficient (evaluation 2), rather insufficient (evaluation 3) and quite insufficient (evaluation 4). Furthermore, the following research questions (RQ) were defined:

- RQ1: What are the results of the evaluation of the quality of service of the selected factors in UPTC-P?
- RQ2: What are the results of the evaluation of the quality of service of the selected factors in UPTC-HK?
- RQ3: What are the results of the evaluation of the quality of service of the selected factors for both UPTCs together?
- RQ4: Which factor was best and worst rated in UPTC-P, UPTC-HK and in both UPTCs together?
- RQ5: Is the evaluation of the quality of service by men and women equal?
- RQ6: Is the evaluation of the quality of service by age groups equal?

The arithmetic mean of the evaluation of the individual factors \bar{x} was used to evaluate RQ 1-4 according to Formula 4, where the answer ‘quite sufficient’ was evaluated as 1, ‘rather sufficient’ as 2, ‘rather insufficient’ as 3 and ‘quite insufficient’ as 4, n is the number of values and x_1, x_2, \dots, x_n are specific values:

$$\bar{x} = 1/n \cdot (x_1 + x_2 + \dots + x_n) [-]. \quad (4)$$

The Mann-Whitney U Test (Wilcoxon Rank Sum Test) in STATISTICA was used to evaluate RQ5-6 because it is a non-parametric test that can be used in place of an unpaired t-test. It is used to test the null hypothesis that two samples come from the same population (*i.e.* have the same median) or, alternatively, whether observations in one sample tend to be larger than observations in the other one [80]. Sen [81] and Hettmansperger and McKean [82] defined two hypotheses as follows – H_0 : The two populations are equal and H_1 : The two populations are not equal. Suppose we have a sample of n_x observations $\{x_1, x_2, \dots, x_n\}$ in one population and a sample of n_y observations $\{y_1, y_2, \dots, y_n\}$ in another population [80]. The test statistic for the Mann-Whitney U Test is denoted U and is the smaller of U_1 and U_2 values, defined in Formulas 5-6 below, where U_1 is the number of times an x_n from population 1 is greater than a y_n from population 2, U_2 is the number of times an x_n from population 1 is smaller than a y_n from population 2, n_1 is the sample size of population 1, n_2 is the sample size of population 2, R_1 is the sum of the ranks for population 1 and R_2 is the sum of the ranks for population 2 [80–82]:

$$U_1 = n_1 \cdot n_2 + \frac{1}{2} \cdot n_1 \cdot (n_1 + 1) - R_1 [-]. \quad (5)$$

$$U_2 = n_1 \cdot n_2 + \frac{1}{2} \cdot n_2 \cdot (n_2 + 1) - R_2 [-]. \quad (6)$$

In the next step, it is necessary to determine the minimum value U of U_1 and U_2 according to Formula 7 [80–82]:

$$U = \min(U_1, U_2) [-]. \quad (7)$$

The critical value of U for two-sided level of significance ($\alpha = 0.05$) can be found in the statistical tables for the Mann-Whitney U test [80–82].

4 Results

The results are presented according to individual research questions (RQ1-6) using the methods described in the previous section. The results of the evaluation of the selected

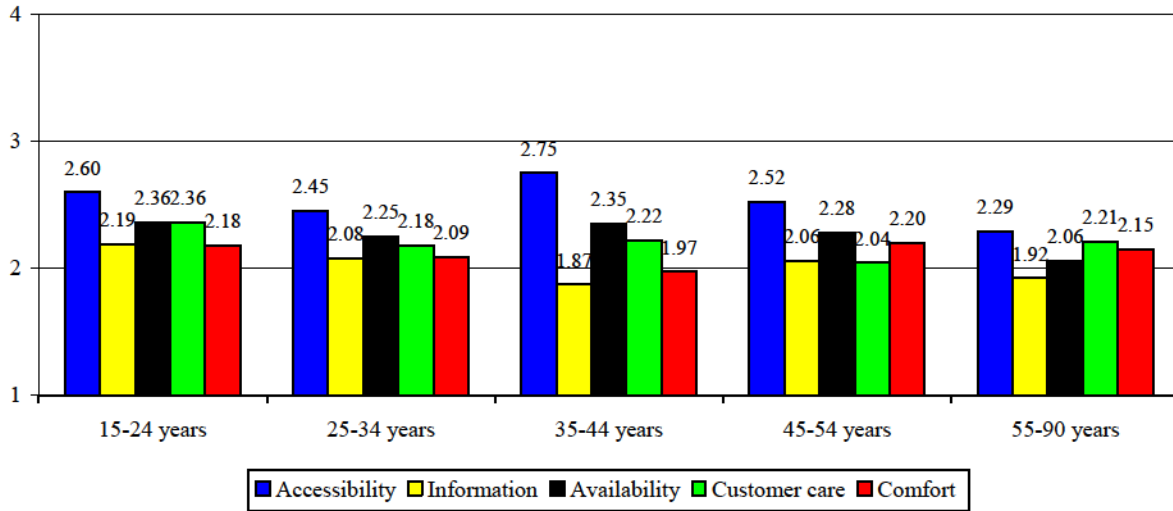


Figure 2: The results of the evaluation of the selected factors in UPTC-P and UPTC-HK by men and age intervals ($n = 394$).

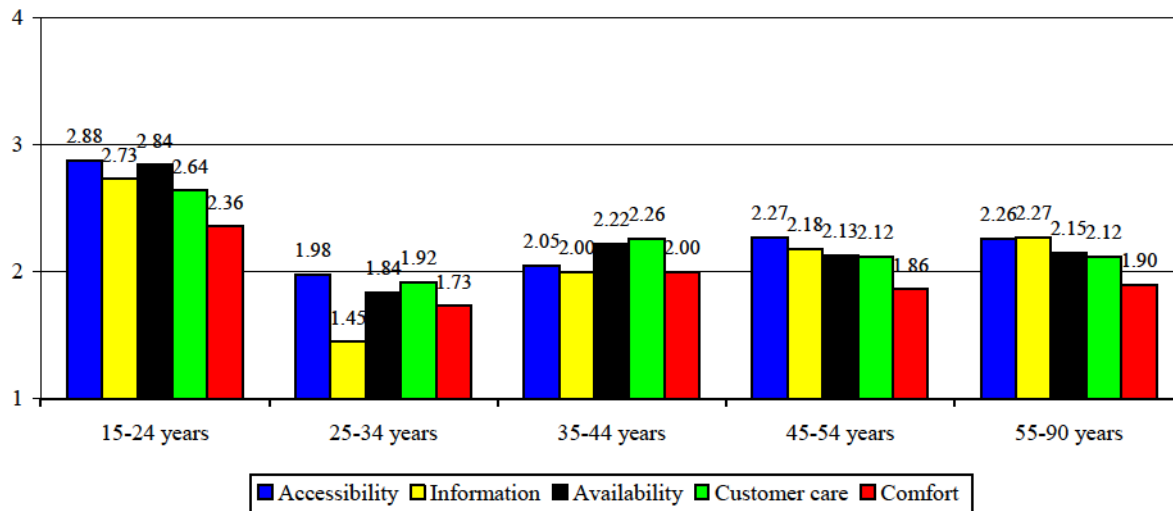


Figure 3: The results of the evaluation of the selected factors in UPTC-P and UPTC-HK by women and age intervals ($n = 406$).

factors in UPTC-P and UPTC-HK by men and age intervals are shown in the Figure 2. Possible answers for the five selected factors were as follows: quite sufficient (evaluation 1), rather sufficient (evaluation 2), rather insufficient (evaluation 3) and quite insufficient (evaluation 4).

The results of the evaluation of the selected factors in UPTC-P and UPTC-HK by women and age intervals are shown in the Figure 3.

The first RQ was: What are the results of the evaluation of the selected factors in UPTC-P? The results of RQ1 are presented in Figure 4. The best evaluation was achieved for the “information provided” factor ($\bar{x} = 1.89$), and the worst evaluation was recorded of “price accessibility” factor ($\bar{x} = 2.55$).

For the price accessibility factor, 41% of men and only 33% of women responded “rather sufficient” (8 percentage points (hereinafter p. p.) difference); 41% of men and only 50% of women responded “rather insufficient” (9 p. p. difference). On this basis, it can be stated that women are of the opinion that price accessibility is rather or quite insufficient (59% of women and 49% of men chose this answer). Women (84%) are more of the opinion that the information provided by the UPTC-P is “quite and rather sufficient” than men (76%). For UPTC-P, the availability factor was evaluated better by women (74%) than by men (68%). An interesting result was identified in the customer care factor, where 13% of men rated it as “quite insufficient”, but only 2% of women chose this answer. The responses to the

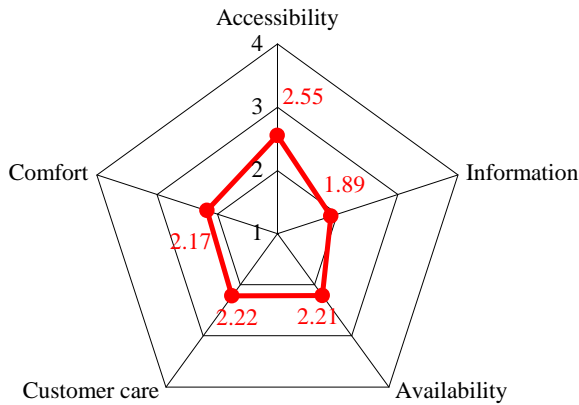


Figure 4: The results of the evaluation of the selected factors in UPTC-P ($n = 400$).

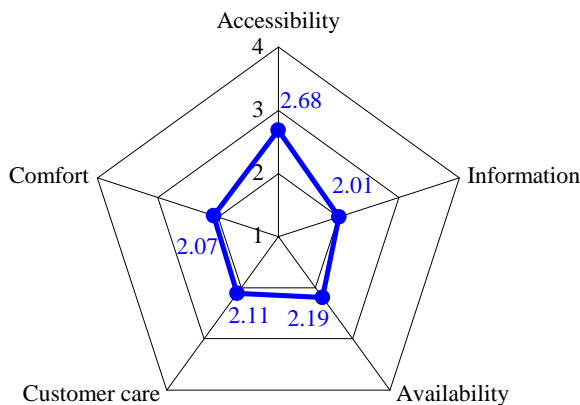


Figure 5: The results of the evaluation of the selected factors in UPTC-HK ($n = 400$).

comfort factor were very similar in terms of frequency for both genders.

The second research question (RQ2) was the same as the RQ1, but RQ2 is focused on the UPTC-HK. The results of RQ2 are presented in Figure 5. The best evaluation was achieved for the “information provided” factor ($\bar{x} = 2.01$), and the worst evaluation was recorded for “price accessibility” factor ($\bar{x} = 2.68$).

For the price accessibility factor, 39% of men and only 27% of women responded “rather sufficient” (12 p. p. difference); 41% of men responded “rather insufficient”, but 55% of women chose this answer (14 p. p. difference). On this basis, it can be stated that women are of the opinion that price accessibility is rather or quite insufficient (68% of women chose this answer, but only 54% of men). An interesting result was recorded for the factor of provided information, when 27% of men rated the provided information as “quite sufficient”, compared to 35% of women with the same answer (8 p. p. difference). 62% of men and 73% of women rated availability as “quite and rather suffi-

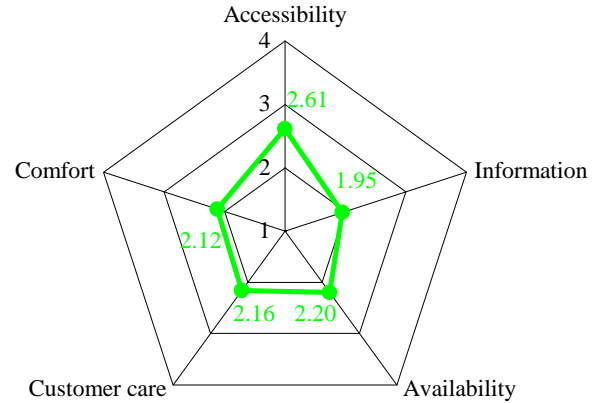


Figure 6: The results of the evaluation of the selected factors in UPTC-P and UPTC-HK ($n = 800$).

cient”, suggesting that men consider availability to be less satisfactory than women. On the other hand, women are more satisfied with the customer care because 82% of them rated it as “quite and rather sufficient”, but only 74% of the males chose this response. Gender differences were identified in the assessment of comfort, as 75% of men chose “quite and rather sufficient”, but 85% of women. It can be stated that women are more satisfied with comfort than men.

The third RQ was: What are the results of the evaluation of the selected factors for both UPTCs together? The results of RQ3 are presented in Figure 6. The best evaluation was achieved for the “information provided” factor ($\bar{x} = 1.95$), and the worst evaluation was recorded for “price accessibility” factor ($\bar{x} = 2.61$).

The price accessibility was assessed as “quite sufficient” mostly by respondents aged 55 to 90 years. It is very likely that there were pensioners in this group who have a discount on fares. 16% of respondents aged 15-24 consider price accessibility as “quite insufficient”. In the 35-44 age groups, 63% of people considered price accessibility to be “rather insufficient”. For information provided, there was a difference in the evaluation by the youngest (aged 15-24) and oldest age group (aged 55-90) of respondents, which may be due to other practices of both generations. 27% of respondents from the youngest age group rated the information provided as “quite sufficient”, compared to all older age groups, who evaluated the information provided as “quite sufficient” (55-90 aged respondents even 39%). The situation where the oldest respondents are significantly satisfied compared to the younger respondents was also recorded for the availability factor. 31% of respondents aged 55-90 considered the service availability as “quite sufficient”, but younger respondents (aged 15-54) chose this answer in 14 to 17% of answers. The youngest

Table 1: The results of the Mann-Whitney U Test for genders and other variables ($n = 800$, $\alpha = 0.05$).

Variable	n_1	n_2	R_1	R_2	p -value	Result
Price accessibility	406	394	171 961.5	148 438.5	0.0042	H_0 rejected
Information	406	394	152 450.5	167 949.5	0.0019	H_0 rejected
Availability	406	394	155 415.0	164 985.0	0.0278	H_0 rejected
Customer care	406	394	158 236.5	162 163.5	0.1815	H_1 rejected
Comfort	406	394	162 845.0	157 555.0	0.9411	H_1 rejected

Table 2: The results of the Mann-Whitney U Test for selected age groups ($\alpha = 0.05$).

Age groups	Variable	n_1	n_2	R_1	R_2	p -value	Result
15-24 and 25-34	Price accessibility	230	132	44 363.0	21 340.0	0.0063	H_0 rejected
25-34 and 35-44	Price accessibility	132	160	16 817.0	25 961.0	0.0004	H_0 rejected
35-44 and 45-54	Price accessibility	160	128	24 678.0	16 938.0	0.0266	H_0 rejected
45-54 and 55-90	Price accessibility	128	150	19 317.0	19 464.0	0.0288	H_0 rejected
45-54 and 55-90	Availability	128	150	19 512.5	19 268.5	0.0132	H_0 rejected
55-90 and 15-24	Price accessibility	150	230	24 586.0	47 804.0	0.0001	H_0 rejected
55-90 and 15-24	Information	150	230	25 568.0	46 822.0	0.0041	H_0 rejected
55-90 and 15-24	Customer care	150	230	24 738.0	47 652.0	0.0002	H_0 rejected
55-90 and 15-24	Comfort	150	230	26 048.0	46 342.0	0.0158	H_0 rejected

group does not consider the quality of customer care as sufficient compared to the oldest group. 33% of respondents aged 15-24 chose answers “rather and quite insufficient” related to the customer care evaluation, however, these answers were chosen only in 13% of respondents aged 55-90. For the comfort factor, the most prevalent responses were “rather sufficient” for all analyzed groups.

The best-rated factor (RQ4) in UPTC-P, in UPTC-HK and in both UPTCs was the information factor (UPTC-P: $\bar{x} = 1.89$, UPTC-HK: $\bar{x} = 2.01$ and UPTC: $\bar{x} = 1.95$). The worst-rated factor (RQ4) was the price accessibility (UPTC-P: $\bar{x} = 2.55$, UPTC-HK: $\bar{x} = 2.68$ and UPTC: $\bar{x} = 2.61$). The biggest difference in the average values of UPTC-P and UPTC-HK was the price accessibility factor with the absolute difference 0.13. Respondents were more satisfied with this factor in UPTC-P. It is possible to identify the barriers to greater use of public transport based on this assessment.

RQ5-6 were evaluated using The Mann-Whitney U Test (Wilcoxon Rank Sum Test) in STATISTICA (Table 1). If the p -value of the statistic test is higher than 0.05, we reject the hypothesis H_1 . It follows that both populations are equal. Otherwise, we reject the hypothesis H_0 , which means that populations are not equal. Table 1 presents the results of the evaluations of men and women (RQ5) using The Mann-Whitney U Test.

Based on the results from Table 1, it can be stated at the significance level of $\alpha = 0.05$ that the evaluation of men and women is not equal for the following analyzed factors:

price accessibility (hypothesis H_0 was rejected – p -value = 0.0042, critical value = 0.05), information (hypothesis H_0 was rejected – p -value = 0.0019, critical value = 0.05) and availability (hypothesis H_0 was rejected – p -value = 0.0278, critical value = 0.05). Customer care and comfort are rated equally by both populations (men and women). The different assessments by men and women may be due to different incomes and hence different perceptions of price accessibility, various information requirements and different requirements on the availability of services. These ideas could be analyzed in further research.

The last research question (RQ6) was focused on differences in the evaluation of factors in different age groups. The Mann-Whitney U Test was used again to evaluate this research question. Successive age groups and the oldest with the youngest were tested. Table 2 presents only those results where the hypothesis H_0 was rejected.

Based on the results from Table 2, it can be stated at the significance level of $\alpha = 0.05$ that the evaluation of selected successive age groups is not equal for the following analyzed factors: price accessibility (comparison of the: 15-24 and 25-34, 25-34 and 35-44, 35-44 and 45-54, 45-54 and 55-90, and 55-90 and 15-24 age groups; hypothesis H_0 was rejected); availability (comparison of the: 45-54 and 55-90 age groups; hypothesis H_0 was rejected); information, customer care and comfort (comparison of the: 55-90 and 15-24 age groups; hypothesis H_0 was rejected). The different assessments of the price accessibility by the age groups

may be due to different age groups have different incomes. Differences in the age groups 55-90 and 15-24 for factors of information, customer care and comfort can be caused by different practices and requirements, technologies used and demands. These ideas could be analyzed in further research.

5 Discussion

The aim of the article was to evaluate the quality of service performed by the urban public transport companies in the Hradec-Pardubice agglomeration and identify some gaps in this area from the perspective of sustainable city logistics. The results were presented in Figure 6, which showed that the best evaluation was achieved for the “information provided” factor ($\bar{x} = 1.95$), and the worst evaluation was recorded for “price accessibility” factor ($\bar{x} = 2.61$).

The results of previous research have shown the following empirical findings according to Ojo [83], namely affordability, availability cost and times, safety, accessibility, reliability, fares, communication and experience, information, ticket price, service frequency, space on the vehicle, cleanliness of the vehicle and ease of use, employee service, available of facilities, reservation and ticketing, safety and security and record of accidents are influence modal choice and the service quality (Abane [84], Borhan *et al.* [85], Kinsella and Caulfield [86], Le-Klähn *et al.* [87], Maruvada and Bellamkonda [88], Morfoulaki *et al.* [89], Sam *et al.* [90], Shaaban and Hassan [91], Tyrinopoulos and Antoniou [92]). In this research some of these factors were used to assess the service quality of the urban public transport companies. However, no similar comparative study could be found to analyze the same factors on a comparable sample.

Dell’Olio *et al.* [49], Chica-Olmo *et al.* [93] and Burlando *et al.* [94] defined variables for the quality of efficient and safe public transport services. There are: comfort, ticket price, supply of the services, waiting time and cleanliness. Based on the results of the research, it can be stated that the variable comfort gained an above-average rating in the agglomeration (UPTCP-P: $\bar{x} = 2.17$, UPTC-HK: $\bar{x} = 2.07$, both UPTC: $\bar{x} = 2.12$). The ticket price and supply of the services factors, described in the study of Chica-Olmo *et al.* [93] and Burlando *et al.* [94], are closely connected with the price accessibility and availability factors analyzed in the research. The price accessibility factor was rated worst in the UPTC-P ($\bar{x} = 2.55$), UPTC-HK ($\bar{x} = 2.68$) and both UPTCs ($\bar{x} = 2.61$). It therefore seems that this is the main barrier to increasing the use of public transport

services in accordance with the concept of sustainable city logistics. The availability factor gained an above-average rating in the agglomeration.

Research in the selected agglomeration showed that respondents are rather satisfied with the quality of services provided (the average value of all monitored quality of service factors is 2.2 - “rather sufficient”). Individual factors are perceived very similarly by respondents in the case of services provided by both UPTC-P and UPTC-HK. Respondents most appreciate the provision of information to passengers.

Respondents (men and women) express the least satisfaction with the accessibility factor. Women in particular consider this factor to be rather unsatisfactory. Different perceptions of this service quality factor are also manifested in relation to age. Especially the age group between 55 and 90 years old (who are granted fare discounts), consider this factor to be fully satisfactory. On the other hand, respondents from the 35-44 age group consider this factor to be unsatisfactory.

In particular, respondents consider the provision of information about urban public transport to be satisfactory. Especially women mention this quality of service factor as fully satisfactory. Significant differences in the perception of quality in the area of providing information to passengers are manifested especially in the age groups of respondents 55-90 and 15-24 years. 83% of older respondents consider the level of service in this area to be entirely satisfactory. It is only 73% of respondents in the age group 15-24 who share this opinion.

Respondents also consider the factors of availability, customer care and comfort to be rather satisfactory. These factors show slight differences in perception of quality with respect to respondents’ age. Respondents from the 55-90 age group perceive the quality of service in these areas more positively than respondents of other age groups. The research also found that the availability factor is perceived positively mainly by women (75% of respondents in this group).

The fact that only five factors were analyzed in the primary research is a limitation of this paper, but selected factors were defined in EN 13816 (Czech standard ČSN EN 13816), and these factors are commonly used for the public passenger transport service quality definition, targeting and measurement. Another limitation is the number of respondents, but according to other studies (*e.g.* Economou *et al.* [77], Girish and Lee [78], Kirby and El Hadidi [79], Kozel [75] and Hague [76]), this is a standard number of respondents for primary research. The use of the Mann-Whitney U Test (Wilcoxon Rank Sum Test) may be a limitation, but it is a standard test to test the null hypothesis

that two samples come from the same population. There are several other statistical tests, with very similar results. The last significant limitation is the fact that the issue of service quality of the urban public transport companies is evolving, so it would be appropriate to carry out further research in this area in the agglomeration or in other agglomerations in the Czech Republic. Among the strengths of this paper is the method used to collect data from respondents, *i.e.* structured personal interviews, because the respondents were in direct contact with the interviewers and fully focused on the questions asked. A further strength was to ensure representivity in terms of gender and age among respondents.

The results presented in this paper will help urban public transport companies in the Hradec-Pardubice agglomeration in their management to adjust the offer of public transport services, because transportation companies will be able to focus on the shortcomings and try to remove them. Furthermore, the research results can be used to benchmark the quality of services provided by other urban public transport companies.

6 Conclusion

From the point of view of sustainable city logistics, it is necessary to increase the number of passengers transported by public transport. The number of passengers using individual car transport within the conurbation should be reduced. The research confirmed that respondents are more satisfied with the quality of services, but the perception of individual factors of service quality differs by individual groups of users. Respondents from the 55-90 age group show the greatest satisfaction with the quality of service in all factors. On the other hand, it was found that companies providing public transport services should focus primarily on the potential of users in the age group of 35-44. Respondents in this age group express their satisfaction with information support, customer care and comfort, but see problems in price accessibility and availability. The research also confirmed a different perception of customer care and comfort by different age groups of respondents (significant differences are mainly between groups of respondents 15-24 and 55-90 years). For all age groups, regardless of gender, price accessibility plays an important role. This factor is perceived the worst by respondents (2.61). Companies providing public transport services should pay attention to the setting of fares and to the fare prices for different groups of passengers. If addressed, the corresponding policy could increase the number of users of public trans-

port within the conurbation. Although the research has confirmed that respondents are satisfied with the information provided by companies, these companies should be encouraged to continue paying attention to the communication with individual groups of passengers. The communication process needs to be adapted to individual groups of users and should make use of the appropriate means of communication for each group.

Acknowledgement: This article is published within realization of the project “Cooperation in Applied Research between the University of Pardubice and companies in the Field of Positioning, Detection and Simulation Technology for Transport Systems (PosiTrans)”, registration No.: CZ.02.1.01/0.0/0.0/17_049/0008394.

References

- [1] Stopka O, Bartuska L, Kampf R. Passengers' Evaluation of the Integrated Transport Systems. *Nase More (Dubr)*. 2015;62:153-7.
- [2] Haghshenas H, Vaziri M. Urban sustainable transportation indicators for global comparison. *Ecol Indic*. 2012;15(1):115-21.
- [3] Florida R. *The Great Reset: How New Ways of Living and Working Drive Post-Crash Prosperity*. New York: HarperCollins; c2010.
- [4] Hart SL. *Capitalism at the Crossroads Aligning Business, Earth, and Humanity*. New Jersey: Wharton School Publishing; c2007.
- [5] Birkin F, Polesie T. *Intrinsic Sustainable Development Epistemology, Science, Business and Sustainability*. Singapore: World Scientific Publishing; c2012.
- [6] Mugion RG, Toni M, Raharjo H, Di Pietro L, Sebathu SP. Does the service quality of urban public transport enhance sustainable mobility? *J Clean Prod*. 2018;174:1566-87.
- [7] McClaren D, Agyeman J. *Sharing Cities. A Case for Truly Smart and Sustainable Cities*. Cambridge: MIT Press; c2015.
- [8] Kauf S. City logistics – a strategic element of sustainable urban development. *Transp Res Procedia*. 2016;16:158-64.
- [9] Cheba K, Saniuk S. Sustainable urban transport – the concept of measurement in the field of city logistics. *Transp Res Procedia*. 2016;16:35-45.
- [10] Nathanail E, Adamos G, Gogas M. A novel approach for assessing sustainable city logistics. *Transp Res Procedia*. 2017;25:1036-45.
- [11] Taniguchi E, Thompson RG, Yamada T. New opportunities and challenges for city logistics. *Transp Res Procedia*. 2016;12:5-13.
- [12] Ehmke JF, Mattfeld DC. Data allocation and application for time-dependent vehicle routing in city logistics. *Eur Trans*. 2010;46:24-35.
- [13] Lin C, Choy KL, Pang G, Ng TW. A data mining and optimization – based real-time mobile intelligent routing system for city logistics. 2013 IEEE 8th International Conference on Industrial and Information Systems. 2013;18-20.
- [14] Teo JS, Taniguchi E, Qureshi AG, Mai VP, Uchiyama N. Towards a safer and healthier urbanization by improving land use footprint of last-mile freight delivery. 2015 Transportation Research Board 94th Annual Meeting. 2015;1-13.

- [15] Xu FQ, Ding N, Lu HF, Liu JG. The data study and analyzing of city logistics system based on cloud platform. *J Chem Pharm Res*. 2014;6:449-55.
- [16] Davidsson P, Henesey L, Ramstedt L, Tornquist J, Wernstedt F. An analysis of agent based approaches to transport logistics. *Transport. Res. Part C*. 2005;13(4):255-71.
- [17] Taniguchi E, Yamada T, Okamoto M. Multi-agent modelling for evaluating dynamic vehicle routing and scheduling systems. *J. of the Easter Asia Soc. for Transp. Stud.* 2007;7:933-48.
- [18] Donnelly R. A hybrid microsimulation model of freight transport demand. Melbourne: The University of Melbourne; c2009.
- [19] Gatta V, Marcucci E, Nigro M, Patella SM, Serafini S. Public Transport-Based Crowdshipping for Sustainable City Logistics: Assessing Economic and Environmental Impacts. *Sustainability*. 2018;11(1):1-14.
- [20] Taniguchi E, Kakimoto Y. Modelling effects of e-commerce on urban freight transport. 2004 3rd International Conference on City Logistics. 2004;135-146.
- [21] Hong X, Jingjing Q, Xingli T. B2C E-commerce vehicle delivery model and simulation. *Informat. Technol. J.* 2013;12(20):5891-5.
- [22] Ehmke JF, Campbell AM. Customer acceptance mechanisms for home deliveries in metropolitan areas. *Eur J Oper Res*. 2014;233(1):193-207.
- [23] Arabi S, Golabchi M, Darabpour M. Sustainable Development in Cities: A Qualitative Approach to Evaluate Rating Systems. *Civ. En. J.-Teh*. 2018;4(12):2990-3004.
- [24] Moayedi M, Kheyroddin R, Shieh I. Determining the Role of Pedestrian-Oriented, Concerning the Public Places: Improvement of Urban Social Capital Quality. *Civ. En. J.-Teh*. 2019;5(4):901-12.
- [25] Zhang L. Big Data, Knowledge Mapping for Sustainable Development: A Water Quality Index Case Study. *Emer. Sc. J.* 2019;3(4):249-254.
- [26] van Duin JH, van Kolck A, Anand N, Tavasszy L, Taniguchi E. Towards an agent based modelling approach for the dynamic usage of urban distribution centres. *Proced.-Soc. and Behav. Sci*. 2012;39:333-48.
- [27] Leonardi J, Browne M, Allen J. Before-after assessment of a logistics trial with clean urban freight vehicles: A case study in London. *Proced.-Soc. and Behav. Sci*. 2012;39:146-57.
- [28] Jorgensen K. Technologies for electric, hybrid and hydrogen vehicles: electricity from renewable energy sources in transport. *Util. Policy*. 2008;16(2):72-9.
- [29] Thompson RG, Taniguchi E. *Future Directions. City Logistics: Mapping the Future*. Florida: CRC Press; c2014.
- [30] Kikuta J, Itoa T, Tomiyama I, Yamamoto S, Yamada T. New subway integrated city logistics system. *Proced.-Soc. and Behav. Sci*. 2012;39:476-89.
- [31] Dablanc L. *Logistics Sprawl and Urban Freight Planning Issues in a Major Gateway City - The Case of Los Angeles. Sustainable Urban Logistics: Concepts, Methods and Information Systems*. Berlin: Springer-Verlag; c2014.
- [32] Hensher DA, Collins AT, Rose JM, Smith NC. Direct and cross elasticities for freight distribution access charges: empirical evidence by vehicle class, vehicle kilometres and tonne vehicle kilometres. *Transp Res, Part E Logist Trans Rev*. 2013;56:1-21.
- [33] Kauf S. *Logistyka miejska i jej baza infrastrukturalna. Przekształcenia strukturalne miast i zrównoważony rozwój gospodarki miejskiej*. Opole: Wydawnictwo Uniwersytetu; c2008.
- [34] Lipowski M. Konsument multikanalowy. Przyczyny i implikacje zjawiska. *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania*. 2014;39:459-69.
- [35] McCormick K, Neij L, Mont O, Ryan C, Rodhe H, Orsato R. Advancing sustainable solutions: an interdisciplinary and collaborative research agenda. *J Clean Prod*. 2016;123:1-4.
- [36] Gehl J. *Cities for People*. Washington: Island Press; c2010.
- [37] Newman P, Beatley T, Boyer H. *Resilient Cities Responding to Peak Oil and Climate Change*. Washington: Island Press; c2009.
- [38] Montgomery C. *Happy City-Transforming Our Lives through Urban Design*. London: Penguin Books; c2013.
- [39] Lehmann S. *Low Carbon Cities, Transforming Urban Systems, Earthscan*. London: Routledge; c2015.
- [40] Vezzoli C, Ceschin F, Diehl J, Kohtala C. Why have 'Sustainable Product-Service Systems' not been widely implemented? Meeting new design challenges to achieve societal sustainability. *J Clean Prod*. 2012;35:288-90.
- [41] Bocken N, Short S, Rana P, Evans S. A literature and practice review to develop sustainable business model archetypes. *J Clean Prod*. 2014;65:42-56.
- [42] Cruz IS, Katz-Gerro T. Urban public transport companies and strategies to promote sustainable consumption practices. *J Clean Prod*. 2016;123:28-33.
- [43] Kampf R, Lizbetin J, Lizbetinova L. Requirements of a transport system user. *Communications*. 2012;14(4):106-108.
- [44] Haghshenas H, Vaziri M, Gholamialam A. Evaluation of sustainable policy in urban transportation using system dynamics and world cities data: a case study in Isfahan. *Cities*. 2015;45:104-15.
- [45] Banister D. The sustainable mobility paradigm. *Transp Policy*. 2008;15(2):73-80.
- [46] Gilbert R, Irwin N, Hollingworth B, Blais P. *Sustainable transportation performance indicators*. Winnipeg: Centre for Sustainable Transportation; c2003.
- [47] Gärling T, Ettema D, Friman M. *Handbook of Sustainable Travel*. Heidelberg: Springer; c2013.
- [48] Chen CF, Chao WH. Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. *Transp Res, Part F Traf Psychol Behav*. 2011;14(2):128-37.
- [49] Dell'Olio L, Ibeas A, Cecin P. The quality of service desired by public transport users. *Transp Policy*. 2011;18(1):217-27.
- [50] Enquist B, Edvardsson B, Sebhatu SP. Values-based service quality for sustainable business. *Manag Serv Qual*. 2007;17(4):385-403.
- [51] Parasuraman A, Zeithaml VA, Berry LL. A conceptual model of service quality and its implications for future research. *J Mark*. 1985;49(4):41-50.
- [52] Sebhatu SP. *Corporate Social Responsibility for Sustainable Service Dominant Logic*. Karlstad: Karlstad University Studies; 2010.
- [53] Edvardsson B. Quality in new service development: key concepts and a frame of reference. *Int J Prod Econ*. 1997;52(1-2):31-46.
- [54] Silaghi S. Quality of Public Transportation Services in Urban Area of Oradea, The J. of the Fac. of Econom. 2010;1:469-74.
- [55] Cruz L, Barata E, Ferreira JP. Performance in urban public transport systems: a critical analysis of the Portuguese case. *Int J Prod Perform Manag*. 2012;61(7):730-51.
- [56] D'Ovidio FD, Legrande D, Mancarella R, Schinzano A, Viola D. A multivariate analysis of the quality of public transport services. *Proc. Econ. and Finan*. 2014;17:238-47.

- [57] Sharaby N, Shifftan Y. The Impact of Fare Integration on Travel Behavior and Transit Ridership. *Transp Policy*. 2012;21:63-70.
- [58] Lai WT, Chen CF. Behavioral Intentions of Public Transit Passengers – The Roles of Service Quality, Perceived value, Satisfaction and Involvement. *Transp Policy*. 2011;18(2):318-25.
- [59] Friman M. Affective Dimensions of the Waiting Experience. *Transp Res, Part F Traf Psychol Behav*. 2010;13(3):197-205.
- [60] Hilmola OP. Benchmarking efficiency of public passenger transport in larger cities. *Benchmarking (Bradf)*. 2011;18(1):23-41.
- [61] Ministry of Transport [Internet]. Praha: Ministry of Transport; c2015. Bílá kniha: Koncepce veřejné dopravy 2015 – 2020 s výhledem do roku 2030; 2015 [cited 2019 September 24]. Available from: [https://www.mdcz.cz/getattachment/Dokumenty/Verejna-doprava/Pravni-predpisy/Zelena-a-bila-kniha-koncepce-verejne-dopravy.pdf.aspx](https://www.mdcz.cz/getattachment/Dokumenty/Verejna-doprava/Pravni-predpisy/Zelena-a-bila-kniha-koncepce-verejne-dopravy/Bila-kniha-koncepce-verejne-dopravy.pdf.aspx)
- [62] Comité Européen de Normalisation. EN 13816, Transportation – Logistics and services – Public passenger transport – Service quality definition, targeting and measurement. Brusel: Comité Européen de Normalisation; 2002.
- [63] Le-Klähn DT, Hall CM, Gerike R. Analysis of visitor satisfaction with public transport in Munich. *J Public Transp*. 2014;17(3):68-85.
- [64] Stopka O, Čejka J, Kampf R, Bartuška L. Draft of the novel system of public bus transport lines in the particular territory. 2015 Transport Means - Proceedings of the International Conference. 2015;39-42.
- [65] Budiono OA. Customer Satisfaction in Public Bus Transport. A Study of Travelers' Perception in Indonesia. Karlstad: Karlstad University Studies; 2009.
- [66] Kampf R, Stopka O, Bartuška L, Zeman K. Circulation of vehicles as an important parameter of public transport efficiency. 2015 Transport Means - Proceedings of the International Conference. 2015;143-146.
- [67] Kampf R, Zeman K, Beneš P. The Determination of the Optimal Variant of Public Bus Line Transport Vehicles in the Daily Circulation. *Nase More (Dubr)*. 2015;62:119-25.
- [68] Imam R. Measuring public transport satisfaction from user surveys. *Int J Bus Manage*. 2014;9(6):106-14.
- [69] Stopka O, Kampf R, Ližbetin J, Hlatká M. Proposal for optimizing the timetables within tram subsystem of urban public transport from the international conception. 2016 Globalization and its Socioeconomic consequences. 2016;2135-41.
- [70] Guiver J, Lumsdon L, Weston R. Traffic reduction at visitor attractions: the case of Hadrian's Wall. *J Transp Geogr*. 2008;16(2):142-50.
- [71] Beirão G, Sarsfield Cabral JA. Understanding attitudes towards public transport and private car: a qualitative study. *Transp Policy*. 2007;14(6):478-89.
- [72] Integrované územní investice Hradecko-Pardubické aglomerace [Internet]. Pardubice: Magistrát města Pardubice; c2016-2018. Vymezení území aglomerace [cited 2019 September 25]. Available from: <http://iti.hradec.pardubice.eu/?site=vymezeni-uzemi-aglomerace>
- [73] Dopravní podnik města Pardubic a.s. [Internet]. Pardubice: Dopravní podnik města Pardubic a.s.; c2009-2018. [cited 2019 September 27]. Available from: <http://www.dpmp.cz/>
- [74] Dopravní podnik města Hradce Králové, a.s. [Internet]. Hradec Králové: Dopravní podnik města Hradce Králové, a.s.; c2017-2020. [cited 2019 September 27]. Available from: <http://www.dpmhk.cz/>
- [75] Kozel R. Moderní marketingový výzkum. Praha: Grada Publishing; c2006.
- [76] Hague P. Průzkum trhu. Brno: Computer Press; c2003.
- [77] Economou M, Souliotis K, Malliori M, Peppou LE, Kontoangelos K, Lazaratou H, et al. Problem Gambling in Greece: Prevalence and Risk Factors During the Financial Crisis. *J Gambl Stud*. 2019 Dec;35(4):1193-210.
- [78] Girish VG, Lee CK. Authenticity and its relationship with theory of planned behaviour: Case of Camino de Santiago walk in Spain. *Curr. Issu. in Touris*. 2019;1-5.
- [79] Kirby DA, El Hadidi HH. University technology transfer efficiency in a factor driven economy: the need for a coherent policy in Egypt. *J Technol Transf*. 2019;44(5):1367-95.
- [80] Shier R. The Mann-Whitney U Test. Mathematics Learning Support Centre [Internet]. [cited 2019 September 28]. Available from: https://www.lboro.ac.uk/media/wwwlboroacuk/content/mlsc/downloads/2.3_mann_whitney.pdf
- [81] Sen PK. On the estimation of relative potency in dilution (direct) assays by distribution-free methods. *Biometrics*. 1963;19(4):532-52.
- [82] Hettmansperger TP, McKean JW. Robust nonparametric statistical methods. London: CRD Press; c2010.
- [83] Ojo TK. Quality of public transport service: an integrative review and research agenda. *Transp. Lett. – The Inter. J Transp Res*. 2019;11:104-17.
- [84] Abane AM. Travel Behaviour in Ghana: Empirical Observations from Four Metropolitan Areas. *J Transp Geogr*. 2011;19(2):313-22.
- [85] Borhan MN, Syamsunur D, Mohd Akhri N, Mat Yazid MR, Ismail A, Rahmat RA. Predicting the Use of Public Transportation: A Case Study from Putrajaya, Malaysia. *The Scient. Wor. J*. 2014:1-9.
- [86] Kinsella J, Caulfield B. An Examination of the Quality and Ease of Use of Public Transport in Dublin from a Newcomer's Perspective. *J Public Transp*. 2011;14(1):69-82.
- [87] Le-Klähn DT, Hall Michael C, Gerike R. Analysis of Visitor Satisfaction with Public Transport in Munich. *J Public Transp*. 2014;17(3):68-85.
- [88] Maruvada DP, Bellamkonda RS. The Effects of Individual Dimensions of Railway Service Quality: Findings from Indian Railway Passenger Services through Developing RAILQUAL. *Int J Innov Manag Technol*. 2012;3:42-5.
- [89] Morfoulaki M, Tyrinopoulos Y, Aifadopoulou G. Estimation of Satisfied Customers in Public Transport Systems: A New Methodological Approach. *J. of the Transp. Res Forum*. 2007;46:63-72.
- [90] Sam EF, Adu-Boahen K, Kissah-Korsah K. Assessing the Factors That Influence Public Transport Mode Preference and Patronage: Perspectives of Students of University of Cape Coast (UCC), Ghana. *Int. J. of Dev. and Sust*. 2014;3:323-35.
- [91] Shaaban K, Hassan HM. Modeling Significant Factors Affecting Commuters' Perspectives and Propensity to Use the New Proposed Metro Service in Doha. *Can J Civ Eng*. 2014;41(12):1054-64.
- [92] Tyrinopoulos Y, Antoniou C. Public Transit User Satisfaction: Variability and Policy Implications. *Transp Policy*. 2008;15(4):260-72.
- [93] Chica-Olmo J, Gachs-Sánchez H, Lizarraga C. Route effect on the perception of public transport services quality. *Transp Policy*. 2018;67:40-8.
- [94] Burlando C, Ivaldi E, Musso E. An indicator for measuring the perceived quality of local public transport: relationship with use and satisfaction with the ticket price. *Riv Int Econ Trasp*. 2016;43:451-73.