Palacký University Olomouc

Transactions on Transport Sciences
Peer-Reviewed Open Access Journal
Vol. 1/2022 DOI: 10.5507/tots.2021.019
journal homepage: www.tots.upol.cz

How Attractive are Public Transport Interchanges? A Cross Comparison of Two European Terminals

GIANNIS ADAMOS, EFTIHIA NATHANAIL

Traffic, Transportation and Logistics Laboratory, University of Thessaly, Pedion Areos, Volos GR-38334, Greece

ABSTRACT: As the world becomes more urbanized, there is a strong need for urban public transport to provide sustainable alternative solutions against private-vehicle usage. However, the opportunities for seamless journeys through public transport are still limited and the need for properly designed and operated transport interchanges is vital. The present paper investigates the perceptions and the users' level of satisfaction when using the New Railway Station of Thessaloniki in Greece and the Riga International Coach Terminal in Latvia, in terms of services provision and station's operation. In total, 36 indicators were tested, grouped in eight quality factors, namely travel information, wayfinding information, time and movement, access, comfort and convenience, station attractiveness, safety and security and emergency situation handling. Attitudinal surveys were implemented to determine key performance factors that affect travelers' satisfaction when using the two terminals. Data were collected through on-line questionnaires and were elaborated through descriptive and inferential statistics, including Mann-Whitney two-sample U-testing to assess differences between the samples in variables measured on a 5-point Likert scale, Spearman bivariate correlations to measure the strength of association between the quality indicators and multiple regression analyses to examine the effect of selected attributes on the general satisfaction level of travelers. Results showed that both interchanges perform better in physical quality attributes, like access, travel and wayfinding information provision, but they do not satisfy users' aesthetics expectations in the internal and external area of the interchanges and the surrounding area and they do not cover adequately their feeling of security and safety in the transfer or waiting areas. These results highlighted the users' preferences and concerns which contribute into a satisfactory overall design of the interchanges. In a nutshell, transport interchange design should satisfy both providing a hub for seamless mobility, but also integrating the station as a part of the public realm.

KEYWORDS: Public transport systems; hubs; travelers' perceptions; sustainability; level of satisfaction.

1. INTRODUCTION

Public transport systems aim at providing travelers with mobility, comfort and safety. Private automobiles have played a significant role in achieving this aim, strengthening travelers' reliance on cars, but also contributing to the failure of urban networks to serve adequately the respective capacity (Chapman, 2007). Environmental issues, such as noise and air pollution also affect the quality of life of citizens (Stanton et al., 2013). Consequently, motorized travel by private cars is not sustainable (Van Wee, 2012) and this means that there is a strong need for public transport systems to provide alternative sustainable means of transport to discourage private-vehicle usage (Nathanail et al., 2018).

At least until accessibility by walking and cycling is essentially improved by changes in land uses, public transport currently is recognized as the most important component of a sustainable transport system (Van Wee and Handy, 2014). Worldwide, the provision of user-friendly public transport systems is vital for the improvement of mobility in cities and the reduction of road transport's contribution to greenhouse gas emissions (Uherek et al., 2010). To this end, governments support managers and operators to establish adequate systems and provide high-quality services to citizens, integrating transport and land use planning and incorporating environmental concerns, in order to attract a larger number of people to public transport (Veeneman and Mulley, 2018). This governmental support includes investments for developing interconnected public transport systems, as a key success factor (Chowdhury et al., 2015) towards providing travelers with more destination choices and potential reduction in travel time and cost (Bak et al., 2012).

Acknowledging that travel behavior change towards lower use of the private car is vital for future sustainability, many transport authorities move into attracting a greater number of people to use public transport (Friman et al., 2013). A sustainable transport system needs to provide an accessible public transport service of high quality. Transport interchanges ensure interconnectivity of transit routes and available public transport modes, which improve system performance and therefore increase the system's attractiveness. This means that transport interchange design and operation towards facilitating combinations of different modes and enabling seamless mobility are important elements of a public transport system.

The process of deciding on choosing private vehicles or public transport is complex and depends on several attributes, including trip characteristics (i.e. short versus long distance) and demographics (i.e. men versus women). Psychological reasons may also affect travelers' choices and their switching to public transport. For example, people prefer private cars due to their symbolic status in a society, but also based on their perceived offered quality of service, in terms of flexibility, convenience and comfort (Friman et al., 2019). On the other hand, public transport service quality is characterized of the ability of the system to provide seamless traveling. However, limited opportunities exist for seamless journeys on public transport, coupled by the fact that the majority of travelers are negatively disposed to make transfers unless the route is attractive in terms of cost and travel time (Chowdhury and Ceder, 2013; Nathanail et al., 2018). It is apparent that user particularities, motivations to use private motor vehicles and quality of public transport services are influential factors for enabling switching from private to mass mode of traveling (Redman et al., 2013).

As transit routes are predetermined, good interconnection and well designed transfer points are necessary to accommodate public transport system and traveler satisfaction. These two are important factors for affecting travelers into choosing sustainable traveling versus private car usage. Transport interchanges are nodal network elements which facilitate interconnectivity among various transport modes and routes and enable transferring between either long and short distance networks or urban and interurban environment. Such transfers may refer to changes of transportation mode and/or vehicles. Integrated design of transport interchanges, in terms of facilities, information and operations comprise the most important attractors of public transport systems and eventually contribute to sustainable traveling (Nathanail et al., 2018). Within this frame, the scope of the paper is to identify key transport interchange attributes which affect travelers to select public transport networks for their journeys. The contribution of the research is that it investigates the perceptions and the users' level of satisfaction by comparing two public transport interchanges in Thessaloniki, Greece and Riga, Latvia, both located in the wider urban area and mainly servicing long-distance trips. Based on this approach, the objectives of the research are structured as follows:

- Cross-compare the two interchanges, indicate similarities and differences, and associate the common or contradictory attributes with the culture of people, the operation of the overall transport system or the quality of services provided at the specific terminals.
- Reveal the level of users' satisfaction from each of the interchanges' operation, infrastructure and services and overall.
- Determine key performance indicators that affect the overall level of users' satisfaction.

The rest of the paper is structured as follows: section 2 includes a literature review about intermodality and the role of interchanges in travelers' overall satisfaction, followed by a brief overview of the two case studies in section 3. The methodological approach and data analysis are given in section 4 and results in section 5. Lastly, section 6 summarizes the main findings of the research and respective conclusions.

2. LITERATURE REVIEW

As the world becomes more urbanized and the demand for mobility is significantly growing, the implementation of sustainable mass transit solutions by public transport authorities is vital (IAPT, 2015). The improvement of accessibility enhances the sustainable dimension of transport systems, since it defines how well the systems enable travelers to reach activities and destinations by means of a combination of transport modes (Geurs and Van Wee, 2004). This cooperation of different transport modes is formulated under the concept of "intermodality", which can improve the long-term sustainability of transport systems (Bak et al., 2012).

The latest European Commission's White Paper (2011) determined three priority areas: people, integration and technology. Addressing goals and actions for the development of a more sustainable transport system till 2050, the Paper characterized intermodal integration as one of the most significant elements of future transport systems (COM, 2011). Good intermodal integration can provide convenient and efficient travel for passengers and consequently reduce the interchange cost of public transport (Bhattacharyay, 2012). When cities enable greater use of integrated transport, traffic congestion and environmental pollution can be reduced (Dacko and Spalteholz, 2014). Nevertheless, intermodality to work as a solution to transport problems, requires a proper design and operation of the transfer points, removal of barriers that obstacle seamless trips and improvement of specific key attributes (Monzon et al., 2017).

Transport interchanges are those network components, in which intermodal integration takes place. The effective planning, design and operation of urban transport interchanges requires an integrated approach, incorporating: land use and transport planning, transport facilities design, safety, security, energy and environment aspects, Information and Communication Technologies (ICT) and public-private partnerships and other business cases (Lucietti et al., 2016). New funding schemes, exploiting such partnerships and business cases are crucial, considering that the construction of a transport interchange station, especially in an urban zone within a metropolitan environment, involves a large investment that usually the state cannot afford (Ibrahim, 2003). In any case, transport interchanges constitute the field of intermodal activities and they are the key element that transport authorities need to improve in order to promote the use of public transport and the provision of seamless mobility. Integrated public transport systems should include seamless transfers in the route network, which reduce duplication and allow for a more efficient operation (Ibrahim, 2003). Chowdhury et al. (2018) recognized five main attributes of an integrated public transport system:

- Network integration, i.e., considering nodes where routes are connected with one another to provide access to several destinations.
- Fare integration, related to ticketing system integration, preferably with no additional costs for transfers and use of the same system by all modes and services.
- Information integration, referring to real-time information provision en route, alternative routes, etc.
- Physical integration of stations, including sheltered walkways among terminals, security measures, appropriate signage and way-finding.
- Coordinated schedules, related mainly to the synchronization of services of different operators.

Sustainable traveling assumes travel choices, which aim to reduce CO_2 footprint and at the same time accommodate mobility demand and provide an acceptable level of quality of service. Public transportation is considered as one of the main means of sustainable mobility, the users of which are therefore considered as sustainable mobility users. Another characteristic of sustainable mobility users may also be considered planning their individual traveling, through the incorporation of environmentally friendly modes, either independently or in combination of available travel modes to achieve a highly sustainable trip. In this sense, transferring facilities are main nodal points, where public transport modes are interconnected, so that they provide a seamless journey. The utilization of these transfer points depends on the willingness of travelers to use public transport, which is affected by their needs, perceptions and expectations. Therefore, it is important to identify the latter factors to assess the attractiveness of public transport network and interchanges. Satisfaction, which can be valuable for understanding customers' experiences, may predict significantly future customer behavior (Oliver, 2010). To this end, satisfaction is a parameter commonly used to evaluate the quality of services provided at transport interchanges (as in Gärling et al., 2018; Nathanail et al., 2018; Soltanpour et al., 2020). Redman et al. (2013) classified public transport service quality attributes in two main groups: *physical*, for example, reliability, frequency, speed, accessibility, price, information provision, ease of transfers/interchanges, vehicle condition, and *perceived*, including comfort, safety, convenience and aesthetics. The first group

refers to attributes that can be measured/assessed without receiving feedback from users, while the attributes of the second group address directly users' experiences, which can be recorded through interviews, on-site and on-line surveys, focus groups, etc.

Focusing on demographics and trip characteristics, it seems that major user groups of public transport are women, students and households without access to cars (Monzon et al., 2017). However, a slight increase of young men using public transport has also been noted in recent years (Aretun and Nordbakke, 2014). In addition, research shows that most of the trips are for leisure purposes (as in Monzon et al., 2017).

Understanding the needs of users is of high importance when evaluating the performance of a transport interchange. Allard et al. (2018) studied the influence of transport transfer quality on intercity passenger mode choice in the Continental Iberian Peninsula and indicated an increase in the perceived value connection insurance/guarantee when the reliability of provided services is lower. The authors also concluded that when travelers are accompanied by persons who rely on them (dependents), transfer time and effort are increasing (Allard et al., 2018). Applying revealed and stated preference surveys in London, Madrid and Helsinki, Hernandez and Monzon (2016) defined crucial parameters that affect travelers' experience and indicated that travel information and signposting reduce users' stress at transport hubs, while factors such as external and internal design, air quality, temperature and noise formulate the level of comfort and pleasure while waiting or transferring. Another study in Spain revealed that independently their socioeconomic characteristic, public transport users consider the quality of the available information as the most important characteristic of their journeys (dell' Olio et al., 2011).

Worldwide, stated-preference surveys conducted at the University of Auckland in New Zealand revealed that travelers seem to be more sensitive to travel cost compared to travel time and that they are willing to sacrifice some minutes and money from their time and cost savings, respectively, in order to get more comfort at the interchange (Chowdhury et al., 2015). Hickman et al. (2015) investigated the development of multimodal passenger rail hubs as part of the high-speed rail network in China and they concluded that the facilities that travelers mostly expect from an interchange are possibility to purchase quickly an (integrated) ticket, easiness to access the interchange, clear and easy to understand signing, safety and security. The study also revealed that even if trip purpose itself is not a significant parameter on the interchange experience, however travelers pay more attention to the architectural design and the availability of shops, based on their trip purposes, i.e., more attention is paid in architecture when users travel for leisure (Hickman et al., 2015).

With the use of basic indicators for the interchange as a whole and specific indicators for interchange elements, Bryniarska and Zakowska (2017), implemented a multi-criteria evaluation of three public transport interchanges in Poland, concluding that the quality of basic infrastructure of platforms meets the technical and quality requirements, however the level of provided accessibility for the disabled people is not adequate, mainly in terms of signage, maps of interchanges, etc. A study of Shanghai Hongqiao comprehensive transport hub showed that travelers' personal and journey characteristics affect the evaluation of the interchange's services, for example, business travelers rated time coordination lower than leisure travelers and retired users pay more attention to luggage delivery facilities (Li and Loo, 2016). The evaluation of five land transport terminals in Spain, France and Sweden, revealed that cleaning, security, quality of shops and accessibility levels are those factors that seem to influence travelers' level of satisfaction (Monzon et al., 2015). Another survey in Berlin addressed users' perspective on intermodality and concluded that the requirements of travelers regarding time efficiency can be met by optimized public transport connections, provision of real-time information, signage and short distances at interchanges, along with parking availability and transporting bikes on public transport option (Oostendorp and Gebhardt, 2018). The evaluation of Moncloa interchange in Madrid, Spain revealed that users consider as of highest importance aspects like comfort inside the interchange, availability of shops and concern about emergency situations (Hernandez et al., 2016). Lastly, eleven terminals assessed in particular how well an interchange as node fits into the surrounding area, taking into account their design and structure attributes (Monzon & Di Ciommo, 2015).

3. CASE STUDIES

The aim of the European Union's project ALLIANCE (ALLIANCE Project, 2016-2018), was the transfer of know-how from Greece to Latvia on assessing performance of transportation interchanges. In this context, a survey was organized at the Riga International Coach Terminal, based on the experience gained by a like survey conducted earlier at the New Railway Station of Thessaloniki, as both interchanges share common operations in providing urban-interurban interconnection in public transport.

3.1 New Railway Station of Thessaloniki

Thessaloniki is the second biggest city in the country and the capital of the prefecture of Central Macedonia, Greece. The population of the city is approximately 1,000,000 residents. The New Railway Station of Thessaloniki is the central passenger interchange terminal in Thessaloniki accommodating railway passengers who travel between the city and the suburban area, as well as other national and international destinations. The interchange also serves as one of the two bus terminals in the city, accommodating urban and interurban buses. The new metro network's terminal, currently being constructed, is also located at the same area. New underground parking and new walking and cycling facilities are expected to be constructed. The metro project will highly affect the surrounding area, providing more incentives for new businesses, attracting housing relocation and increasing land and property value in the area.

The station is located in the urban area of Thessaloniki, next to the "Western Exit" Highway, and relatively close to the central business district. The station is also close to the port of Thessaloniki, and there is a bus line connecting the railway station with the Central Interurban Bus Terminal located in the west part of the city and with the International Airport of Thessaloniki, "Macedonia", located in the east part. The modes of transport provided at the specific interchange are: suburban and interurban rail, urban, suburban and interurban buses, taxis, bicycles, park-and-ride, kiss-and-ride and metro (under construction). The ridership that uses the station daily comprises of an average of 138,000 bus passengers traveling in the urban zone and 22,500 passengers traveling in the suburban zone, on a total of 12 bus lines. The average daily number of railway passengers arriving at/or departing from the station is approximately 6,000. Of these, 4,500 use tickets issued by electronic systems, and 1,500 use paper tickets (Nathanail et al., 2018).

3.2 Riga International Coach Terminal

Riga International Coach Terminal (RICT) is one of the most important transport interchanges in Latvia. The terminal cooperates with 30 passenger transportation companies,

16 of which ensure domestic transportations, 18 international transportation and 12 of them are foreign companies. Riga city and surrounding municipalities formulate the main regional metropolis, accounting for approximately 60% of the population of the country with 1,006,943 registered residents (CSB, 2017). The capital city covers an area of 303,996 km^2 and offers a variety of urban and regional transport options, like urban, regional, national and international buses, regional and national rail services, ferries to nearby countries and an urban international airport.

RICT is located in the city center and provides easy interfaces to other transport modes, located at the heart of the capital. Yatskiv et al. (2017) investigated the case of long-distance trips among the capital cities of Baltic States and concluded that analyzing the current accessibility level affects significantly the future development of territories, regions and cities. The authors also considered the role of Riga public transport system in determining the level of accessibility for different spatial aspects and RICT was recognized as an interchange that has a crucial role in facilitating the shift from the traditional use of a car to public transport. The modes of transport provided at the specific interchange are: international, national and urban bus connections, taxis, bicycles, park-and-ride and kiss-and-ride. On average, the terminal maintains 420 routes daily, 350 of which are domestic and 70 are international routes, serving more than 2 million passengers (RD PAD, 2017).

4. METHOD AND ANALYSIS

4.1 Setting up travelers' attitudinal surveys

In order to capture users' perceptions and the level of satisfaction when using the two terminals, travelers' attitudinal surveys were organized, and data were collected through on-line questionnaires (Adamos et al., 2019). Based on the findings of literature review (section 2) and the research work conducted in the framework of the European Commission project "City-HUB", the questionnaires enabled the assessment of eight groups of indicators (hereinafter quality factors), including (City-HUB, 2013): travel information, wayfinding information, time and movement, access, comfort and convenience, station attractiveness, safety and security and emergency situation handling.

The selected quality factors and the respective indicators reflect the five main attributes for servicing transfers upon traveling (Chowdhury et al., 2018), as quality factor "access" depicts the network's integration, the quality factor "travel information" refers to information and fare integration, the quality factor "wayfinding information" addresses the physical integration of stations and the quality factor "time and movement" depicts coordinated schedules. In addition to the above quality factors, the overall satisfaction of users was recorded. In total, 36 indicators were assessed by users on a 5-point Likert scale, with 1 being the lowest possible score and 5 being the highest. The indicators assigned in each quality factor are presented in Table 2. Supplementary data were also collected, regarding trip characteristics, such as trip purpose, and demographics, like gender, age, education level, employment status and net-income per month.

In Thessaloniki, the survey was carried out between May 2013 and October 2013 via SurveyMonkey (https://www.surveymonkey.com/) and a prize draw was offered to participants. The process was the following: a card marked with a "Survey number" was distributed to the interchange users, including information about the survey goal, the survey website and details about the prize draw. Based on the survey number, each respondent had individual access to the online tool of the survey through personal computers, smartphones and tablets. In addition, each user, who received this card was recorded in a control sheet, including the survey number, date, time, location, gender and age, etc., so as to validate that the respondent was the user that received the card at the interchange. The responses recorded by SurveyMonkey were then exported to a database and were analyzed (Hernandez and Monzon, 2016). In total, 2,000 cards were distributed, and 258 responses were received (response rate: 12.9%), from which the valid ones were 244.

In Riga, the survey was realized in Spring 2017 and was available in English, Latvian and Russian. After the experience of the low response rate in Thessaloniki, owing to the impersonal mode through internet platform, the survey in Riga was based on in-situ personal interviews, which led to a completion of the 239 questionnaires.

In both cases, random sampling was applied, and the appropriate techniques were adopted, i.e. typical days of the week (excluding weekend) and different time per day were chosen, respondents were approached by selecting one person, skipping the next two, interchanges' space was widely covered, i.e. terminal, ticket sales points, shops, etc.

Considering that there were not any significant interventions in policy, infrastructure or passenger traffic as regards the operation of the interchanges during the period 2013-2017, it can be assumed that this year difference in the realization of the surveys does not affect the comparison of the interchanges' attributes.

It is also noted that data collection was anonymous and in compliance with the European Union's General Data Protection Regulation (GDPR). Data were kept safe and protected from unauthorized access.

4.2 Data analysis

Data were analyzed through descriptive and inferential statistics. In the first case, a number of the sample characteristics, such as size, age and gender were addressed by estimating the frequency distribution per characteristic. In the second case, the statistical analysis of the responses was carried out using non-parametric tests. Specifically, in order to estimate whether there were any differences in the average rating of the 36 indicators between the two interchanges, hypothesis testing was used: the null hypothesis H_0 was that the median difference between the pairs is zero and the alternative hypothesis H_1 was that the median difference is not zero. Mann-Whitney two-sample U-testing was performed to assess differences between the samples in characteristics measured on the 5-point scale.

In addition, Spearman bivariate correlations were calculated between the quality factors, multiple regression analyses were conducted to examine the effect of selected factors on the general satisfaction level of travelers and prediction models were developed. The power of the models was evaluated according to the value of the adjusted R square (adjusted R^2), as it is not prone to increase with the addition of new independent variables in the model as compared to R^2. It is also used when comparing equations' performance in adjusting in more than one not interrelated data sets (Draper and Smith, 1997). Constructs were built by combination of the measured indicators, using alpha test (Cronbach, 1951), where Cronbach a>0.6. A confidence level of 95% and confidence interval of 5% were assumed.

5. RESULTS

This section gives an overview of the sample profiles and trip patterns in the selected interchanges and includes the results of the assessment of the level of satisfaction of users, the construction of bivariate correlations between quality factors and the respective prediction models, explaining travelers' overall satisfaction.

5.1 Sample profiles and trip patterns

A summary of the profile of the respondents, i.e., gender, age, educational level, employment status, monthly net income and number of people in household, as well as some trip patterns are presented in Table 1.

In Thessaloniki interchange, the final sample size was defined to 244 users, of which 60% are women and the remaining 40% men. Regarding age, most of the respondents are between 18-25 years old (47%) and highly educated (62%). Focusing on the employment status, it was observed that respondents are mainly employed (42%) and students (38%), while 56% of the users have monthly net-income less than 1,000 EUR. Focusing on trips' patterns in Thessaloniki, it was observed that the overwhelming majority (66%) uses a few times a week or less frequently the interchange. In addition, the main purpose of trips is leisure or visiting family and friends (56%) and most travelers (45%) do more than one transfer.

In Riga interchange, the final sample size was defined to 239 users, of which 62% are women and the remaining 38% men. Most of the respondents are between 18-25 years old (35%), highly educated (55%), employed (64%) with a monthly net-income less than 500 EUR (45%). Most travelers use the interchange a few times a month (20%) or less frequently (58%), the main trip purpose is leisure (59%) and most of them (73%) do not do any transfer.

Concluding, in both terminals, the sample is characterized by similar demographic attributes, in terms of gender, age, occupation, education and income, regardless that the surveys were conducted in different years. Also, there is a high similarity observed in the purpose and frequency of terminal usage. The main difference that distinguishes the role of each interchange in accommodating travelers is that New Railway Station of Thessaloniki is mostly used as a transfer point, as it interconnects local and interurban traveling on road and rail, whereas Riga International Coach Terminal basically services bus trips.

5.2 Cross-case analysis

To fulfil the first objective and cross-compare the two interchanges, 36 indicators were assessed, and potential similarities and/or differences were indicated. Table 2 includes the average rating (M) and standard deviation (SD) of each variable per interchange, the statistic parameter Mann-Whitney U and p-value, indicating the strength of the respective evidence.

It was observed that users in Riga rated higher almost all indicators compared to the rating that travelers in Thessaloniki provided and the majority of these differences were statistically significant (p-value<0.05). Exceptions are met in indicators "transfer distances between different modes" and "numbers and variety of coffee-shops and restaurants", in which Thessaloniki's users' average rating was 3.9 (SD=1.05) and Riga's 3.8 (SD=0.97) in the first case, and 3.3 (SD=1.04) and 3.1 (SD=1.23) in the second case. However, these differences were not statistically significant (p-value=0.05).

In Thessaloniki interchange, the three higher rated indicators were: transfer distances between modes (M=3.9, SD=1.05), distance between the facilities and services (M=3.7, SD=0.98) and ease of access to/from the terminal (M=3.7, SD=1.1). On the other hand, users seem to be less satisfied with how pleasant they consider the surrounding area (M=1.9, SD=1.08), the internal design of the terminal (M=2.2, SD=1.02) and how secure they feel in the transfer and waiting areas during the evening or night (M=2.3, SD=1.1).

In Riga interchange, the higher rated indicators were: ease of access to/from the terminal (M=4.1, SD=0.88), availability

Characteristics	Proportion (%)		Characteristics	Proportion (%)	
	Thessaloniki	Riga		Thessaloniki	Riga
Gender			*Number of people in household*		
Female	60	62	1-2	34	41
Male	40	38	3	18	22
Age			≥4	48	37
<17 years	3	3	*Trip purpose*		
18-25 years	47	35	Work	18	17
26-40 years	41	28	Education	17	10
41-65 years	9	30	Leisure or visiting family and friends	56	59
>66 years	0	3	Other	9	14
Would prefer not to say	0	1	*Frequency of using the interchange*		
Educational level			More than 4 days a week	16	5
High	62	55	3 or 4 times a week	8	7
Secondary	36	39	Once or twice a week	10	10
Primary	2	6	Few times a month	24	20
Employment status			Less frequently	42	58
Employed	42	64	*Number of transfers*		
Unemployed	16	3	0	26	73
Student	38	24	1	29	18
Other	4	9	≥1	45	9
*Monthly net-income**					
Low	56	45			
Medium	32	27			
High	12	28			

*Thessaloniki: low: <1,000€, medium: 1,000€-1,500€, high: >1,500€, Riga: low: <500€, medium: 500€-800€, high: >800€

Table 1. Summary of sample characteristics and trip patterns.

and ease of use of travel information at the terminal (M=4.0, SD=0.94), accuracy and reliability of travel information displays (M=4.0, SD=0.92) and ticket purchase (M=4.0, SD=1.0). The lowest rating by users in Riga received the following indicators: the internal (M=2.8, SD=1.16) and external (M=2.9, SD=1.15) design of the terminal, the surrounding area (M=2.9, SD=1.16) and the feeling of security in the transfer and waiting areas during the evening or night (M=2.9, SD=1.16).

Despite the fact that the survey collected travellers' (subjective) perceptions about the terminals related to several attributes, it is notable that the average rating of the different indicators is strongly correlated with the "actual" characteristics of the two terminals, meaning, for example, that real-time travel information provision is absent indeed or that the feeling of insecurity during the late evening is expected due to the areas the terminals are located, i.e. low density of residencies in the surroundings, etc.

Figure 1 depicts the comparative evaluation of users' satisfaction based on the quality factors, constructed by the respective indicators and the factor indicating the overall

Quality factors	Indicators	Thessaloniki (TH)		Riga (R)		Mann-Whitney U	p-value
		M	SD	M	SD		TH vs. R
Travel information	Availability and ease of use of travel information at the terminal	3.2	1.03	4.0	0.94	17184	0*
	Availability of travel information (timetables, routes, delays) before your trip	3.3	1.02	3.9	1.0	18729	0*
	Accuracy and reliability of travel information displays for bus/ trains at the terminal	3.4	1.06	4.0	0.92	19815	0*
	Ticket purchase	3.6	1.13	4.0	1.0	23060	0*
Wayfinding information	Signposting to different facilities and services	3.3	1.1	3.7	1.05	24566	0.002*
	Signposting to transfer between transport modes	3.2	1.08	3.3	1.12	27882	0.39
	Information and assistance provided by staff	3.2	1.18	3.6	1.08	24170	0.001*
Time and movement	Transfer distances between different modes	3.9	1.05	3.8	0.97	26269	0.05
	Co-ordination between different transport operators or transport services	3.2	1.02	3.4	1.02	25057	0.005*
	Use of your time (transferring & waiting)	3.1	1.14	3.5	1.05	22895	0*
	Distance between the facilities and services	3.7	0.98	3.9	1.0	24494	0.001*
	Ease of movement due to number of people	3.5	1.06	3.6	1.06	27582	0.29
Access	Ease of access to/from the terminal	3.7	1.1	4.1	0.88	24327	0.001*
Comfort and convenience	General cleanliness of the terminal	3.0	1.04	3.3	1.14	24105	0.001*
	Temperature, shelter from rain and wind, ventilation, air conditioning	3.1	1.04	3.6	1.08	22094	0*
	General level of noise of the terminal	2.8	1.1	3.4	1.04	20915	0*
	Air quality, pollution (e.g. emissions from vehicles)	2.6	1.14	3.2	1.11	20699	0*
	Number and variety of shops	3.1	1.11	3.1	1.16	29068	0.95
	Number and variety of coffee-shops and restaurants	3.3	1.04	3.1	1.23	26255	0.05
	Availability of cash machines	3.0	1.05	3.5	1.12	21915	0*
	Availability of seating	2.8	1.06	3.2	1.20	23512	0*
	Availability of mobile phone signal and Wi-Fi	3.0	1.15	3.6	1.21	20805	0*
	Comfort due to the presence of information screens	2.9	1.08	3.6	1.02	18690	0*
Station attractiveness	The surrounding area is pleasant	1.9	1.08	2.9	1.16	14831	0*
	The internal design of the terminal	2.2	1.02	2.8	1.16	20648	0*
	The external design of the terminal	2.4	1.1	2.9	1.15	21695	0*
Safety and security	Safety getting on and off the transport mode	2.8	1.06	3.5	0.92	18750	0*
	Safety whilst inside the terminal	2.8	1.1	3.2	1.12	23640	0*
	Feeling secure in the transfer & waiting areas (during the day)	3.0	1.05	3.4	1.1	23736	0*
	Feeling secure in the transfer & waiting areas (during the evening/night)	2.3	1.1	2.9	1.25	22062	0*
	Feeling secure in the surrounding area	2.4	1.16	2.9	1.17	22971	0*
	Lighting	3.0	1.07	3.7	0.98	18345	0*
Emergency situation handling	Information to improve your sense of security	2.9	1.05	3.2	1.06	25033	0.005*
	Signposting to emergency exits	3.1	1.07	3.5	1.08	22515	0*
	Location of emergency exits in case of fire	2.9	1.03	3.4	1.12	21237	0*
Overall satisfaction	Overall score of user satisfaction	3.1	0.84	3.5	0.79	22415	0*

*M: Average rating, SD: Standard Deviation, *Statistically significant, p-value<0.05*

Table 2. Average rating and summary test results for the comparison between the two interchanges.

satisfaction of users. It seems that respondents are quite satisfied with access both in Thessaloniki (M=3.7, SD=1.10) and Riga (M=4.0, SD=0.89). Travelers in Riga are also quite satisfied with travel information (M=4.0, SD=0.80), while in Thessaloniki they are neither satisfied nor dissatisfied (M=3.4, SD=0.85). Somehow satisfied users seem to be with time and movement with average rating 3.5 (SD=0.77) in Thessaloniki and 3.7 (SD=0.82) in Riga. Similar results are met in wayfinding information, comfort and convenience, and emergency situation handling, which neither satisfy nor dissatisfy travelers. On the other hand, users are dissatisfied with the stations' attractiveness both in Thessaloniki (M=2.2, SD=1.06) and Riga (M=2.9, SD=0.94). Similar results are met in safety and security issues. Overall, users in Riga are more satisfied (M=3.5, SD=0.79) than those in Thessaloniki (M=3.1, SD=0.84).

Within the same terminal, users perceive comparable level of satisfaction to all quality factors, with access and travel information being the highest and station attractiveness the lowest. This indicates a similarity in the priorities set by the operators regarding design and operation. The clear prominence of Riga's terminal over Thessaloniki's in all indicators can be attributed to the role of the first as the terminal of the overall trip, as opposed to the role of the second, which accommodates mostly transfer between local and interurban traveling thus more complicated operations are valuated.

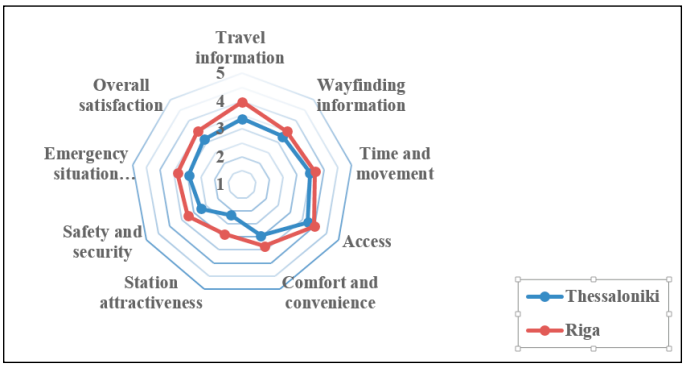

Figure 1. Comparative average rating of quality factors.

5.3 Parameters affecting users' satisfaction

This section includes the investigation of the interrelationships between users' overall satisfaction with the eight quality factors and age, all treated as explanatory parameters of the level of satisfaction. It is noted that through hypothesis testing, the eight quality factors were tested against several parameters, like demographics (gender, education, employment, income, etc.) and trip patterns (purpose, frequency, transfers) expressed in categorical variables, but there were not indicated any statistically significant differences in neither interchange. To this end, bivariate correlations were calculated between the ordinal variables, i.e. quality factors and age. Results are depicted in Table 3 for Thessaloniki interchange and Table 4 for Riga interchange. This analysis allows to meet the second objective of the study and determine the level of users' satisfaction from the current interchanges' operation, infrastructure and services.

Based on the outcomes of Table 3 and focusing on Thessaloniki interchange, it was observed that the overall satisfaction of users is more related to "comfort and convenience" (β=.708, p-value<0.01) and "emergency situation handling" (β=.700, p-value<0.01) and less related to "access" (β=.473, p-value<0.01). A neutral positive relationship was defined with the remaining quality factors. On the other hand, a negative statistically significant correlation was recorded between satisfaction and age (β=-.177), but this relationship was not statistically significant (p-value>0.05).

Similar findings were revealed in Riga interchange (Table 4). In this case, it was indicated that the overall satisfaction of users is more related to "station attractiveness" (β=.733, p-value<0.01) and "safety and security" (β=.732, p-value<0.01) and less related to "access" (β=.490, p-value<0.01). A neutral positive statistically significant relationship was indicated between satisfaction and the remaining quality factors (p-value<0.01).

5.4 Prediction of users' satisfaction

Based on the findings of the previous section and taking into account the necessary statistical requirements and assumptions (i.e. homoscedasticity, multicollinearity, etc.), a prediction model for each interchange was developed, associating the overall satisfaction of users (dependent variable) with specific quality factors (independent variables). To this end, it is possible to meet the third objective of this study and determine those key performance indicators through the respective quality factors that affect the level of users' satisfaction.

It is noted that several alternative combinations of variables were tested, and those explaining better future users' satisfaction, i.e. significant contribution of variables in the prediction, higher values of adjusted R^2, are depicted in Table 5 and analyzed in the following paragraphs.

For the case of Thessaloniki interchange, the overall satisfaction of users is associated with "travel information", "wayfinding information", "station attractiveness", "safety and security" and "emergency situation handling". The regression is significant (F(5, 243)=99.035, p-value<0.05) and explains 70% of variance. Based on the values of the indicator Beta (Table 5), "travel information", "safety and security" and "emergency situation handling" seem to be the strongest predictors of satisfaction, contributing significantly to the total variances (p-value<0.05). The weakest construct is "wayfinding information" (β=.113) and this contribution is not statistically significant (p-value>0.05).

In Riga interchange, the overall satisfaction of users is associated with "travel information", "comfort and convenience", "station attractiveness", "safety and security" and "emergency situation handling". The regression is significant (F(5, 238)=99.175, p-value<0.05) and explains 68% of variance. Based on the values of the indicator Beta (Table 5), "station attractiveness" seems to be the strongest predictor of satisfaction, contributing significantly to the total variances (p-value<0.05). The weakest construct is "emergency situation handling" (β=.156), and this contribution is statistically significant (p-value<0.05).

Summing up, station attractiveness was among the strongest factors explaining user satisfaction, meaning that good appearance makes the interchanges more attractive to users who already have or tend to have a sustainable perspective in their travel habits. This result supports also findings of previous research that architectural design affects leisure travelers and expands them to all travelers (Hickman et al., 2015). Similarly, other factors of similar importance travelers' satisfaction in both interchanges were travel information, safety and security and emergency situation handling. This indicates that focusing on these factors, the operator may affect significantly the level of satisfaction and presumably increase the utilization and servicing of the interchange.

In both terminals, it was observed that the overall satisfaction of travellers is highly associated with travel information provision, highlighting the need that successful operation of different modes of transportation in a hub is strongly dependent of the synergies developed among different operators, which need to provide integrated accurate and dynamic information, as well as integrated ticketing options, etc. On the other hand, in the case of Thessaloniki, way-finding in-

Quality factors	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Overall satisfaction	-	-	-	-	-	-	-	-	-	-
2. Travel information	.640**	-	-	-	-	-	-	-	-	-
3. Wayfinding information	.651**	.671**	-	-	-	-	-	-	-	-
4. Time and movement	.590**	.586**	.667**	-	-	-	-	-	-	-
5. Access	.473**	.495**	.529**	.569**	-	-	-	-	-	-
6. Comfort and convenience	.708**	.531**	.668**	.686**	.499**	-	-	-	-	-
7. Station attractiveness	.647**	.479**	.470**	.417**	.368**	.664**	-	-	-	-
8. Safety and security	.696**	.500**	.608**	.590**	.474**	.708**	.671**	-	-	-
9. Emergency situation handling	.700**	.564**	.646**	.532**	.371**	.658**	.589**	.648**	-	-
10. Age	-.177**	-.174**	-.089	-.041	-.041	-.140	-.163*	-.098	-.167**	-

***p-value<0.01, *p-value<0.05*

Table 3. Bivariate correlations of the individual factors and their relationship with the variable characterizing overall satisfaction – Thessaloniki interchange.

Quality factors	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Overall satisfaction	-	-	-	-	-	-	-	-	-	-
2. Travel information	.555**	-	-	-	-	-	-	-	-	-
3. Wayfinding information	.598**	.638**	-	-	-	-	-	-	-	-
4. Time and movement	.629**	.640**	.703**	-	-	-	-	-	-	-
5. Access	.490**	.550**	.525**	.592**	-	-	-	-	-	-
6. Comfort and convenience	.723**	.542**	.608**	.658**	.496**	-	-	-	-	-
7. Station attractiveness	.733**	.431**	.533**	.605**	.460**	.724**	-	-	-	-
8. Safety and security	.732**	.506**	.522**	.630**	.439**	.715**	.712**	-	-	-
9. Emergency situation handling	.663**	.448**	.588**	.512**	.477**	.623**	.581**	.638**	-	-
10. Age	.089	.068	-.035	.013	-.012	.085	.104	.192**	.012	-

***p-value<0.01, *p-value<0.05*

Table 4. Bivariate correlations of the individual factors and their relationship with the variable characterizing overall satisfaction – Riga interchange.

Quality factor	Thessaloniki					Riga				
	B	Std. Error	Beta	t	Sig.	B	Std. Error	Beta	t	Sig.
Travel information	.234	.054	.237	4.331	<.05	.188	.044	.191	4.274	<.05
Wayfinding information	.099	.052	.113	1.912	.057					
Comfort and convenience						.187	.060	.196	3.101	<.05
Station attractiveness	.156	.049	.176	3.208	<.05	.190	.043	.256	4.374	<.05
Safety and security	.202	.053	.227	3.832	<.05	.175	.052	.205	3.337	<.05
Emergency situation handling	.202	.048	.235	4.163	<.05	.127	.041	.156	3.054	<.05
Constant	.529	.132		3.993	<.05	.574	.159		3.614	<.05
	Adjusted R^2=.70, F(5, 243)=99.035					*Adjusted R^2=.68, F(5, 238)=99.175*				

Table 5. Regression analyses of overall satisfaction of travelers at Thessaloniki and Riga interchanges.

formation seems to affect less travellers' overall satisfaction. This can be explained by the fact that at the specific terminal, the space between buses and trains platforms is well distinguished and travellers feel comfortable to move.

6. CONCLUSIONS AND DISCUSSION

Even if national governments and local authorities make efforts to persuade travelers to switch to public transport as a sustainable mode, it seems that people still rely on private automobiles, congesting the road network and contributing to excessive fuel consumption and pollutants' emissions.

Acknowledging the role of transport interchanges in the performance of seamless traveling on the public transport network, the aim of the present research was to investigate travelers' perceptions and satisfaction when using the two interchanges. From this investigation, the result was to identify key factors, which affected the quality of the offered service. Interpreting the findings of this research, which result from the analysis of two interchanges in two different European countries, it is observed that both interchanges perform better in physical quality attributes, like access, travel and wayfinding information provision, but lag behind in meeting users' expectations for better aesthetics in the internal and external area of the interchanges and the surrounding areas or covering adequately their feeling of comfort, security and safety in the transfer or waiting areas, especially during the evening or night. Similar importance of these components

has been identified in previous studies, which revealed that travelers pay special attention to comfort, security and safety inside the interchange (as in Chowdhury et al., 2015; Monzon et al., 2015; Hernandez et al., 2016). On top of that, as humanity came across the COVID-19 outbreak and acknowledging its impact on mobility and transport services, particularly health safety and security of passengers and workers comprise the top priority of interchange managers and operators. The European Commission issued guidelines on the progressive restoration of transport services and connectivity due to COVID-19, highlighting (indicative) measures such as (EC, 2020):

- Provision of more detailed trip planning, i.e. information about average occupancy rates for specific itineraries;
- Reduction of passengers' density in transit points or waiting areas, by setting up dedicated lanes or removing facilities that encourage crowding. Off-peak hour travel should also be encouraged with appropriate incentives (e.g. adjusted pricing);
- Implementation of protocols at transport hubs for the immediate isolation of persons with suspected COVID-19 infections, by setting up designated areas and training staff appropriately.

The higher scores of Riga interchange as compared to Thessaloniki's interchange are attributed to the relevant location of the two interchanges, with the first being closer to the central business district, thus more accessible to other feeding modes, i.e. walking, cycling, and trip generators (housing, offices and shopping, etc.). These characteristics affect time efficiency, which is highly considered by travelers when choosing mode or intermodal terminal (Oostendorp and Gebhardt, 2018) and can explain that travelers in Riga are overall more satisfied than those in Thessaloniki. Finally, comfort and convenience and wayfinding information were identified as key factors affecting satisfaction locally in Riga and Thessaloniki, respectively.

It is clear that transport interchange facilities is an important player as concerns public transportation popularity and preference instead of private vehicle usage, and should be considered under three main dimensions (Lamiquiz et al., 2014):

- As mobility hub, in order to facilitate intermodal integration.
- As station, providing adequate infrastructure for access and egress.
- As part of the public realm, meeting people expectations for high quality urban life.

The latter dimension is in accordance with the current trend in transport hubs, which implies that urban transport interchanges can function, additionally to traveling facilities, as places, where other activities can occur, such as spaces for leisure, shopping, meeting people, etc. (Atmodiwirjo, 2008). In addition, cities would benefit from providing such multifunctional public open spaces, allowing people to travel with safety and comfort, but also meet and interact with others within the context of whole community, including local social connections, cultural groupings, family relationships, etc. (Holland et al., 2017). The overall profit for future cities with well-designed transport interchanges is the establishment of mobility and social sustainability grounds.

Concluding, the added value of this research is the methodological approach, which incorporates findings of previous studies, but also covers state-of-the-art attributes affecting users' satisfaction. The proposed method can facilitate the wider possible identification and appropriate selection of key factors that can be assessed in order to evaluate the quality of services provided at transport interchanges. The validation of the method at the two European terminals opens ground to an integrated approach, either for global benchmarking purposes or to draw valid conclusions when comparative evaluation of terminals is desired or required.

REFERENCES

Adamos, G., Nathanail, E., Yatskiv (Jackiva), I., Budilovich (Budilovica), E. & Tsami, M. (2019). Measuring travellers' and stakeholders' satisfaction on perceived sustainability of a transport interchange. *Transport and Telecommunication*, *20* (4), 379-388.

Allard, R. & Moura, F. (2018). Effect of transport transfer quality on intercity passenger mode choice. *Transportation Research Part A*, *109*, 89-107.

ALLIANCE Project (2016-2018). Retrieved from https://alliance-project.eu/.

Aretun, Å. & Nordbakke, S. (2014). Developments in driver's license holding among young people: potential explanations, implications and trends. Rapport 824A. Statens vägoch transportforskningsinstitut, Linköping.

Atmodiwirjo, P. (2008). The use of urban public places in Jakarta for adolescents' hanging out. *Journal of Asian Architecture and Building Engineering*, *7*, 339–346.

Bak, M., Borkowski, P. & Pawlowska, B. (2012). Types of solutions improving passenger transport interconnectivity. *Transport Problems, 7* (1), 27–36.

Bhattacharyay, B. N. (2012). Seamless sustainable transport connectivity in Asia and the Pacific: Prospects and challenges. *International Economics and Economic Policy*, *9* (2), 147–189.

Bryniarska, Z. & Zakowska, L. (2017). Multi-criteria evaluation of public transport interchanges. *Transport Research Procedia, 24*, 25–32.

Chapman, L. (2007). Transport and climate change: a review. *Journal of Transport Geography, 15* (5), 354–367.

Chowdhury, S., Ceder, A. & Schwalger, B. (2015). The effects of travel time and cost savings on commuters' decision to travel on public transport routes involving transfers. *Journal of Transport Geography*, *43*, 151-159.

Chowdhury, S., Hadas, Y., Gondalez, V. & Schot, B. (2018). Public transport users' and policy makers' perceptions of integrated public transport systems. *Transport Policy, 61*, 75-83.

Chowdhury, S. & Ceder, A. (2013). The effects of interchange attributes on public transport users' intention to use routes involving transfers. *Psychology and Behavioral Sciences*, *27* (1), 5–14.

City-HUB (2013). Deliverable D3.2. Guide for Smart and Efficient Design.

COM (2011). Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. White Paper. COM (2011) 144 final. European Commission. Brussels, Belgium.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrical*, *16* (3), 297–334.

CSB (2017). Central Statistical Bureau. Retrieved from http://www.csb.gov.lv/en/dati/statistics-database-30501.html.

Dacko, S. G., & Spalteholz, C. (2014). Upgrading the city: Enabling intermodal travel behaviour. *Technological Forecasting and Social Change*, *89*, 222–235.

Dell' Olio, L., Ibeas, A., Cecin, P. & Dell' Olio, F. (2011). Willingness to pay for improving service quality in a multimodal area. *Transportation Research Part C*, *19*, 1060-1070.

Draper, N. & Smith, H. (1997). Applied regression analysis (2nd edition). John Wiley and Sons, Inc.

European Commission (2020). Guidelines on the progressive restoration of transport services and connectivity – COVID-19. Communication from the Commission (2020/C 169/02).

Friman, M., Fujii, S., Ettema, D., Garling, T. & Olsson, L.E. (2013). Psychometric analysis of the satisfaction with travel scale. *Transportation Research Part A*, *48*, 132–145.
Friman, M., Garling, T. & Ettena, D. (2019). Improvement of public transport services for non-cycling travelers. *Travel Behaviour and Society, 16*, 235-240.
Garling, T., Bamberg, S. & Friman, M. (2018). The role of attitude in choice of travel, satisfaction with travel, and change to sustainable travel. In: Albarracin, D. & Johnson, B.T. (Eds.), Handbook of Attitudes: Applications. Routledge, London.
Geurs, K.T. & Van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: review and research directions. *Journal of Transport Geography*, *12*, 127–140.
Hernandez, S. & Monzon, A. (2016). Key factors for defining an efficient urban transport interchange: users' perceptions. *Cities*, *50*, 158–167.
Hernandez, S., Monzon, A. & Ona, R. (2016). Urban transport interchanges: A methodology for evaluating perceived quality. *Transportation Research Part A*, *84*, 31-43.
Hickman, R., Chen, Ch-L., Chow, A. & Saxena, Sh. (2015). Improving interchanges in China: the experiental phenomenon. *Journal of Transport Geography, 42*, 175–186.
Holland, C., Clark, A., Katz, J. & Peace, S. (2017). Social interactions in urban public spaces. Joseph Rowntree Foundation.
Ibrahim, M. F. (2003). Improvements and integration of a public transport system: The case of Singapore. *Cities*, *20* (3), 205–216.
International Association of Public Transport (2015). Public Transport Trends. Executive Summary.
Lamiquiz Dauden, F., Caprio-Pinedo, J. & Garcia-Pastor, A. (2014). Transport interchange and local urban environment integration. *Procedia-Social and Behavioral Sciences, 160*, 215-223.
Li, L. & Loo, B. (2016). Towards people-centered integrated transport: A case study of Shanghai Hongqiao Comprehensive Transport Hub. *Cities, 58*, 50–58.
Lopez-Lambas, M.E. 7& Monzon, A. (2010). Private funding and management for public interchanges in Madrid. *Research in Transportation Economics*, *29*, 323-328.
Lucietti, L., Hoogendoorn, C. & Cre, I. (2016). New tools and strategies for design and operation of urban transport interchanges. *Transportation Research Procedia, 14*, 1240-1249.
Monzon, A., Alonso, A. & Lopez-Lambas, M. (2017). Joint analysis of intermodal long distance-last mile trips using urban interchanges in EU cities. *Transportation Research Procedia*, *27*, 1074-1079.
Monzon, A. & Di Ciommo, F. (Eds.) (2015). CITY-HUBs: Sustainable and Efficient Interchange Stations. Taylor and Francis, Oxford.
Nathanail, E., Tsami, M. & Adamos, G. (2018). Exploring and evaluating users' satisfaction and perceptions at an urban transport hub. Proceedings of the 7th Transport Research Arena TRA2018, April 16-19, Vienna, Austria.
Oliver, L.R. (2010). Satisfaction. A behavioral perspective on the consumer. McGraw-Hill, New York, USA.
Oostendorp, R., & Gebhardt, L. (2018). Combining means of transport as a users' strategy to optimize traveling in an urban context: empirical results on intermodal travel behavior from a survey in Berlin. *Journal of Transport Geography*, *71*, 72–83.
RD PAD (2017). The economic profile of Riga 2017. Riga: Riga city council Development department.
Redman, L., Friman, M., Garling, T., Hartig, T. (2013). Quality attributes of public transport that attract car users: A research review. *Transport Policy*, *25*, 119-127.
Soltanpour, A., Mesbah, M. & Habibian, M. (2020). Customer satisfaction in urban rail: a study on transferability of structural equation models. *Public Transport*, *12*, 123-146.
Stanton, N.A., Mcilroy, R.C., Harvey, C., Blainey, S., Hickford, A., Preston, J.M. & Ryan, B. (2013). Following the cognitive work analysis train of thought: exploring the constraints of modal shift to rail transport. *Ergonomics, 56* (3), 522–540.
Uherek, E., Halenka, T., Dorken-Kleefel, J., Ballanski, Y., Berntsen, T., Borrego, C., Gauss, M., ... Schmid, S. (2010). Transport impacts on atmosphere and climate: land transport. *Atmospheric Environment*, *44*, 4772–4816.
Van Wee, B. & Handy, S. (2014). Do future land-use policies increase sustainable travel? In: Garling, T., Ettema, D. & Friman, M. (Eds.), Handbook of Sustainable Travel. Springer Science, Dordrecht, The Netherlands, 231–242.
Van Wee, B. (Ed.) (2012). Keep Moving, Towards Sustainable Mobility. Eleven International Publishing, Hague, The Netherlands.
Veeneman, W. & Mulley, C. (2018). Multi-level governance in public transport: Governmental layering and its influence on public transport service solutions. *Research in Transportation Economics, 69*, 430-437.
Yatskiv (Jackiva), I., Budilovich (Budilovica), E. & Gromule, V. (2017). Accessibility to Riga Public Transport Services for transit passengers. 10th International Scientific Conference Transbaltica 2017: Transportation Science and Technology. Vilnius: *Procedia Engineering*, *187*, 82-88.