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Digital transformation possibilities in public transportation in Debrecen

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Abstract

For people living in big cities, getting to their destinations every day is a significant challenge. The increasing use of private transport leads to congestion in cities, contributing to air pollution, increased journey times, and citizens' dissatisfaction. At the end of 2020, the European Commission presented its green, innovative, and affordable mobility plan, the "Sustainable and Smart Mobility Strategy." The strategy's main aims are to reduce transport emissions by 90% by 2050 and improve digitalization based on innovative technologies and methods. To motivate citizens to use public transportation, meeting the passengers' requirements is crucial. At the beginning of 2022, research was carried out in Debrecen on the expectations for public transport. In this paper, the authors present the main results of the survey, focusing on the digitalization part of the survey. Based on the results, 69% of the citizens prefer digital solutions to their everyday lives. The introduction and development of digital solutions such as real-time passenger information would shift more than half of respondents from individual transport to public transport. A proposal was made to introduce complex applications which, in addition to journey planning, also provide additional convenient functions, such as payment and live news. The results can be used to improve the Smart City Program and the Sustainable Urban Mobility Plan (SUMP).

Keywords: public transportation, smart city, consumer expectations, digitalization

Introduction

Public transport plays an essential and increasingly important role in urban mobility. The smooth operation and continuous improvement of service quality are necessary to ensure that the urban population uses these means of transport. In recent years, there has been a shift in travel patterns towards private transportation in many parts of the world (Nagy-Toth, 2020). The pandemic has exacerbated this trend, with a sharp drop in the number of passengers using public transport in cities due to the virus situation. In Hungary, the COVID-19 measures, such as the mandatory use of masks, distance control, and free parking, have also pushed the population towards using private transport.

The combined effect of these factors leads to significant congestion in cities, especially during the morning and afternoon peak hours. To maintain the quality of urban life and urban mobility, redirecting people towards public transport is necessary. It requires improving the accessibility of the service and providing the quality of travel that residents expect.

The European Commission presented its 'Sustainable and Smart Mobility Strategy' and an Action Plan of 82 initiatives. This strategy lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. As outlined in the European Green Deal, the result will be a 90% cut in emissions by 2050, delivered by an innovative, competitive, safe,

accessible, and affordable transport system (European Commission, 2021). To make the goals a reality, the strategy identifies 82 initiatives in 10 key areas for action, each with concrete measures. Of the ten key areas, five are related to sustainability, 2 to smart transport, and 3 to resilient, as *Table 1.* shows.

Table 1: Key areas of the Sustainable and Smart Mobily Strategy

Goals	Key areas
Sustainability: Making transport more sustainable	1. Boosting the uptake of **zero-emission vehicles, vessels and airplanes, renewable & low-carbon fuels**, and related infrastructure - for instance, by installing 3 million public charging points by 2030. 2. Creating **zero-emission airports and ports** – for instance, through new initiatives to promote sustainable aviation and maritime fuels. 3. Making **interurban and urban mobility healthy and sustainable** - for instance, by doubling high-speed rail traffic and developing extra cycling infrastructure over the next ten years. 4. **Greening freight transport** – for instance, by doubling rail freight traffic by 2050. 5. **Pricing carbon and providing better incentives for users** – for instance, by pursuing comprehensive measures to deliver fair and efficient pricing across all transport.
Smart: Innovation and digitalization will shape how passengers and freight move around in the future.	1. Making **connected and automated multimodal mobility** a reality – for instance, making it possible for passengers to buy tickets for multimodal journeys and freight to switch between transport modes seamlessly. 2. Boosting **innovation and data and artificial intelligence** (AI) for more innovative mobility – for instance, fully supporting the deployment of drones and crewless aircraft and further actions to build a European Common Mobility Data Space.

Table 1 (Continued)

Goals	Key areas
Resilient: Transport has been one of the sectors hit hardest by the COVID-19 pandemic.	1. **Reinforce the Single Market** - for instance, through reinforcing efforts and investments to complete the Trans-European Transport Network (TEN-T) by 2030 and support the sector to build back better through increased investments, both public and private, in the modernization of fleets in all modes. 2. Make **mobility fair and just for all** – for instance, by making the new mobility affordable and accessible in all regions and for all passengers, including those with reduced mobility and making the sector more attractive for workers. 3. Step up **transport safety and security** across all modes - including by bringing the death toll close to zero by 2050

Source: Authors' own editing based on (European Commission, 2021)

It seems that 2 of the ten main goals are specifically aimed at digital transformation. People need a multimodal experience when travelling, driven by digitalization and automation. Systems must be introduced that make the transport system more efficient and sustainable while ensuring data protection and privacy rules are respected, and cyber security will be a top priority. Artificial Intelligence (AI) is becoming indispensable for automating transport in all modes through digital technologies. The digital transformation of the transport and mobility sector will require further data availability, accessibility, and exchange efforts. A common European mobility data space is therefore necessary. The aim is to collect, link, and make available data to meet the EU objectives, from sustainability to multimodality. In order to implement the European Mobility Strategy, each Member State must make improvements that will enable it to achieve the objectives set out in the strategy. This requires an understanding of the current situation and of the public's expectations regarding mobility and digitalisation. Therefore, the aim of this article is to present an assessment of public transport habits and expectations in Debrecen in order to identify future improvements.

Literature review

A bibliometric analysis was prepared to explore the literature and analyze and discuss the topic of digitalization on public transportation. The analysis covered the connected areas studied by scientific articles and the countries of the publications. The authors used the freely available bibliometric software VOSviewer 1.6.17 (Van Eck - Waltman, 2013) to examine the keywords of articles that address the research's theme, identify the relationships between them, and analyze bibliographic linkages between countries. This was done using the Web of Science Core Collection - Clarivate Analytics database. It searched for academic journal articles and conference proceedings containing the word "Digitalization" and "public transportation," examining their occurrence in the title, abstract, keywords provided by the authors, and Keyword Plus. The search reveals that the topic has been around since the 1990s, but there has been an explosion of research in the last year. 75% of the 454 articles examined were written between 2015 and 2022. The database analyzed yielded 454 records related to our search terms and can aid us in understanding the field more comprehensively.

The software used identified 2238 keywords in the studies analyzed. Out of the 2238 keywords, 65 keywords met the threshold with a minimum occurrence rate of 5 times which were reduced to 60 keywords using a thesaurus. The VOSviewer software uses colors to show the different clusters identified during the analysis. The program also generates a QR code, which can be scanned to access a dynamic display of the contact network. The relationship network between the relevant keywords is depicted in (Figure 1) and should be interpreted as follows: the size of the points represents the frequency of occurrence; the line thickness connecting the points represents the frequency of co-occurrence of each keyword, and the distance between each point represents the strength of the relationship between the keywords. In the database we created, the minimum occurrence for the relationships between keywords had to be five.

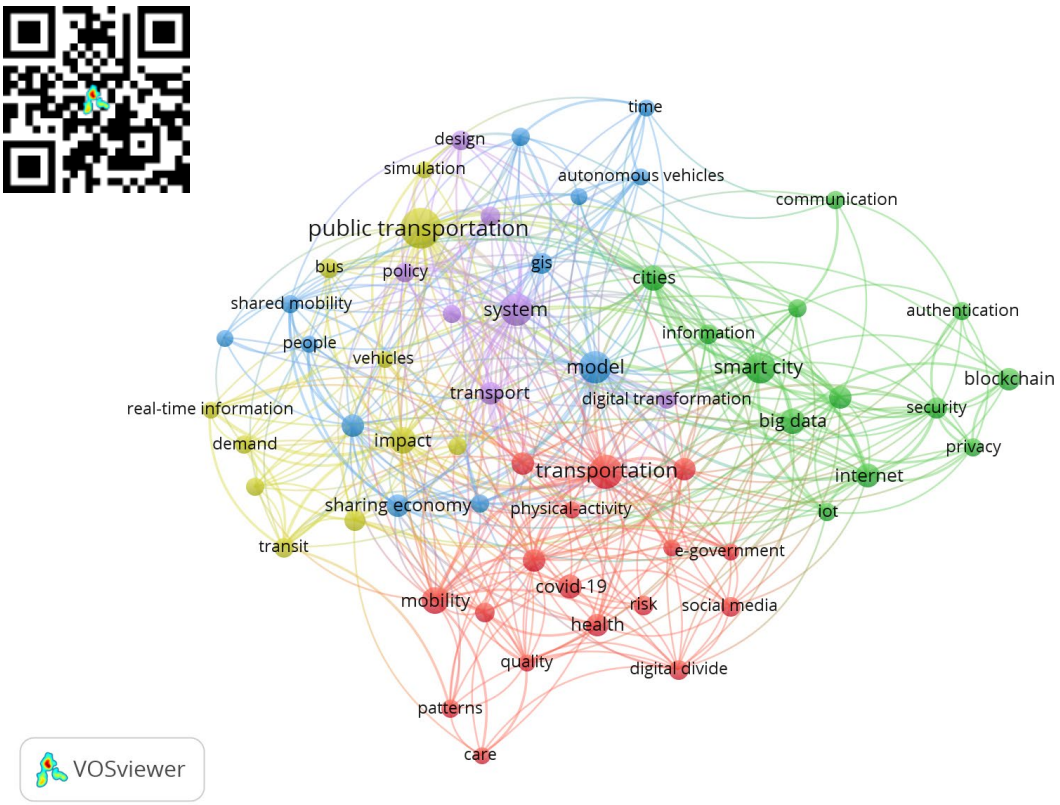

Figure 1: Public transportation digitalization bibliometric analysis results

Source: own editing, based on the VOSviewer analysis, 2022

Five clusters were identified, maintaining the software's default resolution setting for generating clusters (resolution=1). The clusters are separated by color (Figure 1) and are included in (Table 2).

Table 2: Clusters generated by VOSviewer

Cluster 1 (red)	Cluster 2 (green)	Cluster 3 (blue)	Cluster 4 (yellow)	Cluster 5 (purple)
Transportation	Smart city	Model	Public transportation	System
Mobility	Big data	Sharing economy	Impact	Transport
Covid-19	Cities	Behavior	Travel	Policy
Framework	Internet	GIS	Bus	Innovation
GPS	Challenges	Accessibility	Transit	Design
Health	Blockchain	Services	Demand	Sustainability
Technology	Security	Shared mobility	Intelligent transportation system	Digital transformation
Digital divide	Information	Autonomous vehicles	Mobility as a service (maas)	
Environment	Authentication	People	Real-time information	
Risk	Communication	Sustainable mobility	Simulation	
Social media	IoT	Time	Vehicles	
Patterns	Management	Uber		
Care	Privacy			
E-government				
Physical-activity				
Quality				
Safety				

Source: own editing, 2022

Most of the keywords in the red cluster refer to the fact that several studies have investigated the impact of the COVID-19 epidemic on public transport, which is why the terms risk, health, and care appear in the context of Covid and transport and mobility. The studies were motivated by the fact that, as we know, one of the industry which got affected due to this epidemic is the Public Transportation Industry (Meena - Sharma, (2020), Park, J - Kim, G (2021), Fumagalli, LAW et al., (2021)).

Terms in the green cluster are related to digitalization and its IT backgrounds, such as data storage, connectivity, blockchain technology, and information. Most large cities have a smart city strategy, as does the city of Debrecen. Our city's smart city concept envisages a smart, innovative, liveable, efficient, sustainable, ethical, just, smart, healthy, and prosperous city. Inac and Hostemel (2022) have published An Assessment Framework for the Transformation of Mobility 4.0 in Smart Cities, where they describe a reference model to support decision-makers with comprehensive assessment data for the digital transformation of cities' transport.

Looking at keywords in the blue cluster, changes in consumer habits emerge. Researchers have looked at the rise of personal transport, the role of sharing economy models such as Uber, and other shared mobility solutions (Jin, ST et al., (2018), Pan – Qiu, 2022), Castellanos et al. (2022)).

Intelligent transportation is also the most common term in the yellow cluster, which includes reducing travel times, promoting sustainable transport, reducing the share of urban transport, making better use of urban transport infrastructure, and reducing air quality pollution from transport. The use of technologies that support urban mobility in terms of environmental protection and low emissions will be promoted, which will require the processing of data generated by smart systems (vehicle GPS coordinates, sensors, and cameras) and the development of open data-based services. An AI-based architecture for supporting digital public services in the smart transportation sector was presented to

demonstrate the highlighted ideas and concepts. Among others, Ianculescu et al. (2019), Fumagalli et al, (2022), Ramirez-Guerrero, et al. (2022) examinated the data intelligence in public transportation. Among the focus areas of the smart city concept, transport plays a prominent role, considering all its alternatives. Thus, the coordination of individual, community, micro-mobility, and sharing-based systems, the organization of urban transport services considering consumer habits, the research, and the context of which also fall under this cluster.

The terms in the purple cluster imply that researchers are investigating innovative, digital solutions to make urban transport sustainable. This cluster also includes the regulations and policies that coordinate the field. Several cities also have Sustainable Mobility Management Plans (SUMPs) for transport development, including projects implementing the smart city strategy.

Methodology

The literature background of the topic was investigated using the bibliometric software VOSviewer, where the terms public transportation and digital were searched in the Web of Science Core Collection - Clarivate Analytics database. After data analysis, the software classified 60 keywords into 5 clusters, revealing the context of the research results on the topic.

Primary data collection included a questionnaire survey and an in-depth interview on public perceptions and expectations of public transport, and relevant experts from the city administration in Debrecen, Hungary's second-largest city, were interviewed to gain a deeper understanding of the topic and to discuss their experiences and opportunities of the digital switchover so far.

The primary research was conducted in 2022. The questionnaire data collection was conducted online in a self-completion format. Completion was voluntary and anonymous. Two hundred forty-one respondents completed the questionnaire, of which 239 were interpretable and usable for analysis.
The questionnaire consisted of four parts. The first part assessed the sociodemographic characteristics of the respondents. The characteristics of the survey sample are presented in Table 3.

Table 3: Demographic data of respondents

Variables	Sample (N=239)	Coding
Sex (%)		categorical variables
Male	53,56	(0 – M,
Female	45,61	1 – F
No response	0,84	2- Nr)
Age (year)		categorical variables
under 18 y	13,81	(0 – <18,
19-25 y	28,87	1 – 18-25
26-40 y	24,27	2 26-40
41-64 y	30,96	3 41-64
over 65 y	2,09	465<)
Educational level (%)		categorical variables
primary school	13,81	(0 –PS
secondary school	37,66	1- SC
higher education	45,61	2 - HE
postgraduate (PhD)	2,93	3 PG)

Table 3 (Continued)

Variables	Sample (N=239)	Coding
Residents in (%)		categorical variables
village	10,08	(0 – V,
small town	25,63	1 – ST,
large city	57,56	2 – LC,
capital	5,04	3 – C
other	1,68	4- other)
Employment		categorical variables
active workers	61,09	(0 –active
inactive workers	2,09	1 – inactive
student	34,73	2 – student,
retired	1,67	3 – retired,
other	0,42	4 – other)

Source: own data collection and editing, 2022

Table 3 clearly shows a similar proportion of women who completed the questionnaire as men. The most significant proportion of respondents was aged 41-64, but a similar proportion of respondents from other age groups responded, the only exception being those aged 65 and over. Only five respondents from this age group responded, so the survey was conducted online, where it is more difficult to reach this age group. In terms of education level, most respondents had a diploma (tertiary education). In terms of place of residence, it can be concluded that almost 60% of respondents live in a chief town of a county, i.e., a large city. Almost 62% of the respondents were active workers, and almost 35% were students. It is also important to mention that the data was collected through a convenience sampling procedure, so the conclusions are not generalizable.

In the second part of the questionnaire, we asked about transport habits and how much a change in certain factors would influence the respondent towards public transport. This was followed by a survey of consumers' expectations of public transport using the SERVQUAL model and a survey of the experiences of those who had already used public transport in Debrecen. A SERVQUAL is an abbreviation used for "Service Quality." It provides a complete scoring system to every industry to assist management with credibility and efficiency and to serve the purpose of service improvement. The SERVQUAL scale was developed based on the ten requisites of quality service in the "Conceptual Model of Service Quality—PBZ Method" (Parasuraman et al., 1985). In 1988, PBZ conducted further research (Parasuraman et al., 1988) and categorized their findings into five determinants: Tangibles, Reliability, Responsiveness, Assurance, and Empathy on the SERVQUAL scale. In this paper, we present the expectation side of the SERVQUAL model, with a focus on the digital aspects.

In addition to the questionnaire survey, in-depth interviews were conducted. Interviews are an essential qualitative research method in which the researcher collects data directly from the participants. Interviews are significant in unfolding opinions and experiences. One of the types of interviews is the in-depth interview. In-depth interviews are mostly long-duration, face-to-face interviews conducted to achieve desired goals. An in-depth interview, also known as one-on-one, is a method of extracting more detailed information or a deep understanding of a subject or concept (Showcase – Parveen, 2018). The in-depth interviews included members of the city administration responsible for transport development and the management of Debrecen Transport Ltd. In-depth interviews were conducted with relevant experts such as the Deputy Mayor of Debrecen, who presented the urban development section. The CEO of Debrecen Transport Ltd, who is responsible for public transport in the city, and the technical director, who talked about the real-time passenger information improvements. The project manager of the Smart

City program in Debrecen, the Smart City project in Debrecen has 16 projects, 4 of which are directly related to public transport, so he mainly gave information on these projects. We also met the leader of the Future of Debrecen movement, with whom he presented sustainable and green developments. The purpose of the interviews was to examine the implementation of the needs identified in the questionnaire in practice, the possibility of their introduction, and to collect and analyze other information related to the digital switchover and the experience of previous measurements.

Results

The questionnaire results showed that the majority of respondents (56%) own a car, of which 51% use it regularly. A further 34% do not own a car, but their family or partner has a car, with only 10% of respondents not owning a car or having a car in the household. The preferred mode of transport of questionnaire respondents within the city is shown in Table 4.

Table 4: Preferred mode of transport by respondents

What mode of transport do you prefer within the city?		
ANSWER	RESPONSE	RATIO (%)
Car (as a driver or as a passenger)	105	44
Motorbike	4	2
Bicycle	33	14
Pedestrian	15	6
Public transportation (bus, tram, metro, trolley)	79	33
Other (roller, e-roller)	3	1
TOTAL	239	100

Source: own data collection and editing, 2022

As shown in Table 4, individual transport dominates, with only 1/3 of respondents choosing public transport. We asked to what extent a change in the following factors would influence respondents' travel behavior and steer them towards public transport, and the results are shown in Figure 2.

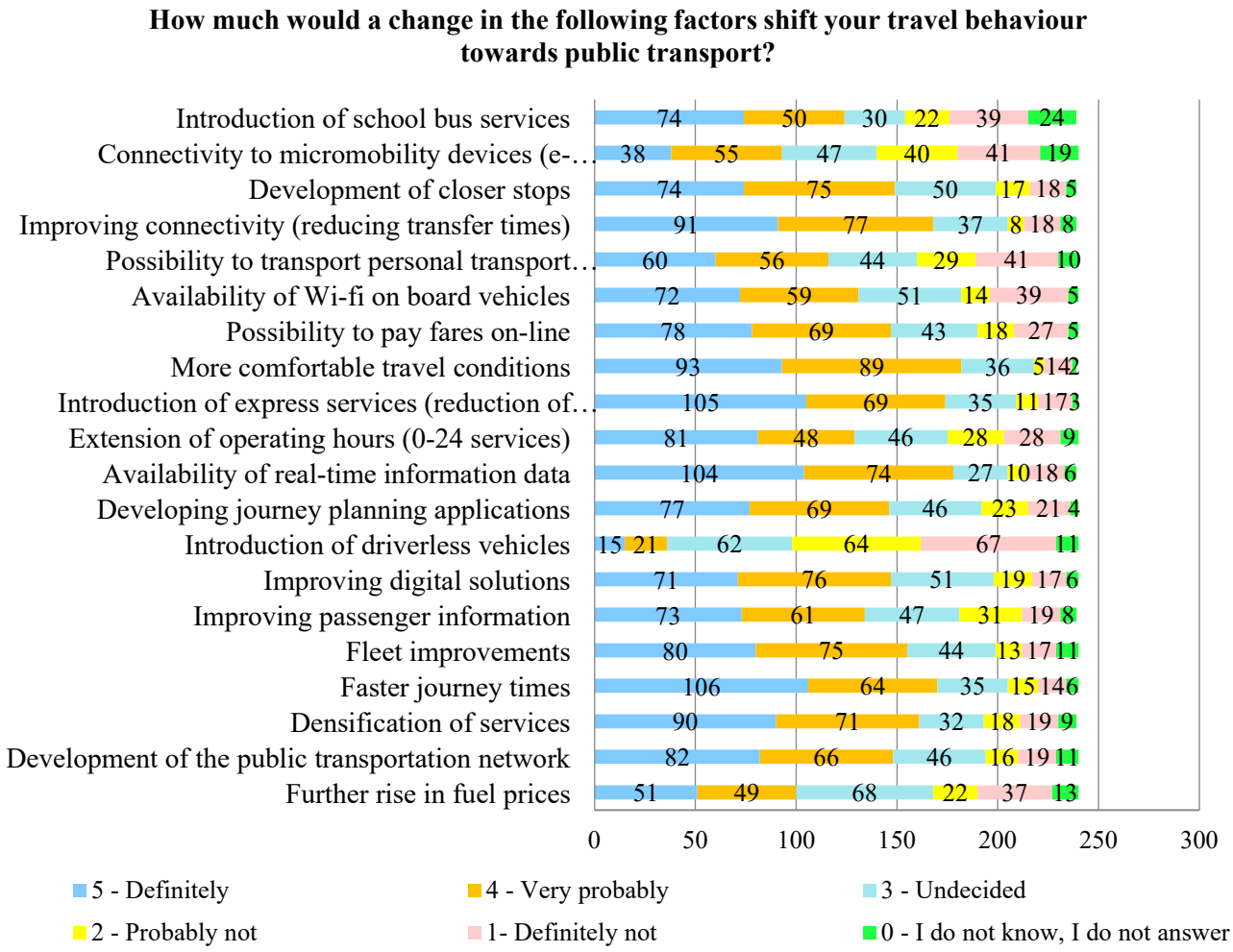

Figure 2: The impact of changes in certain factors on the preference for public transport

Source: own data collection and editing, 2022

Based on the responses, it can be seen that two broad groups of responses would make public transport significantly more attractive, one related to reducing journey times (faster journey time, express services) and the other related to digitalization (real-time information). In the case of digital solutions, 31% of respondents said "definitely," and the other 32% answered "very probably," which means almost 2/3 of the respondents can be influenced by digitalization. The real-time information system development significantly impacts transportation habits, as 44% chose "definitely" and 31% the "very probably" option. These two answers covered ¾ of the sample. Although factors supporting the digital switchover would have a significant positive impact on the use of public transport, one area was much less attractive than expected for respondents, and that is the introduction of self-driving buses.

This may be due to a lack of confidence in this technology, and the human factor is significant for consumers in services, including public transport.

The research also looked at the overall perception and take-up of digitalization. The survey found that all respondents have a smartphone and that only 2.5% of respondents have rejected digital solutions in their daily lives (such as online payments and managing their affairs through apps), while almost half of respondents (49%) use them entirely and a further 20% use digital solutions mostly in their everyday life.

Next to the questionnaire, consumer needs were assessed using the SERVQUAL model. The respondents indicated how important the aspects of public transport were to them on a Likert scale, thus formulating consumer expectations. The questionnaire examined 27 factors, but in this study, only those factors related to digitalization are presented in Figure 3. As a result, consumers' digital expectations of public transport can be formulated.

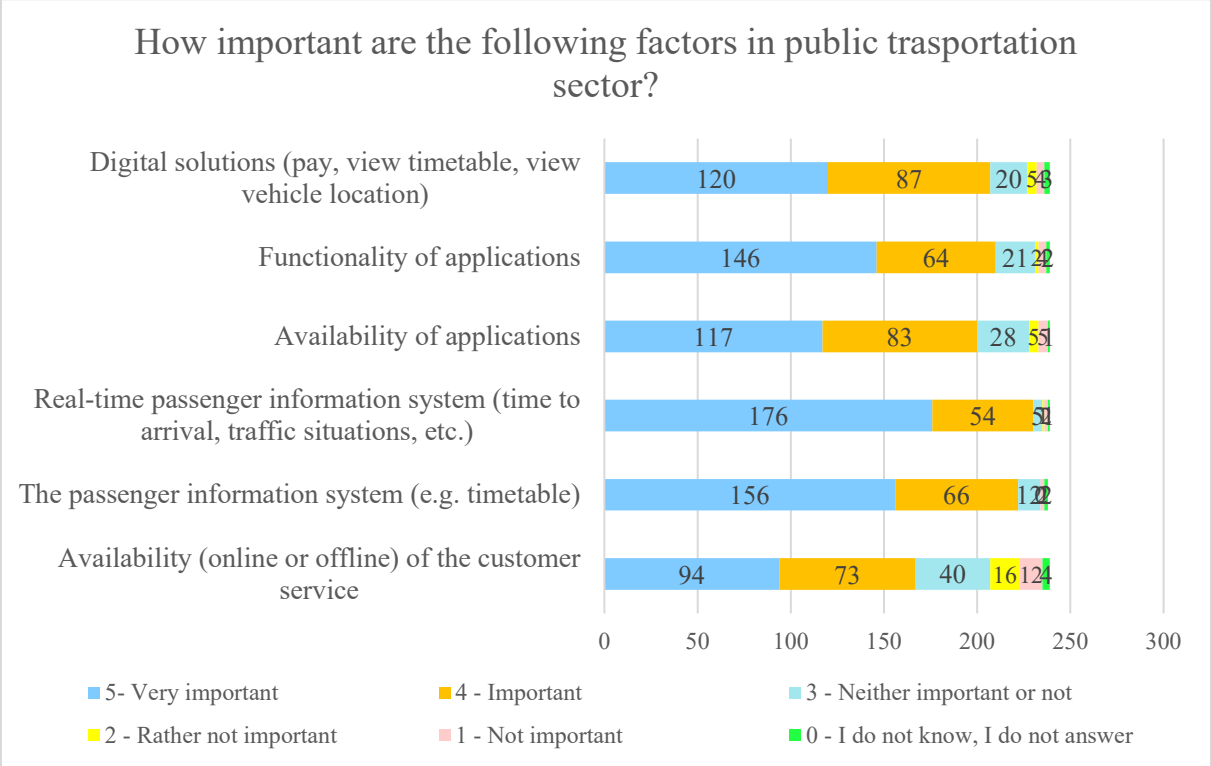

Figure 3.: The digital expectations of consumers in public transport

Source: own research and editing, 2022

Among the results of the in-depth interviews, the most important was the rise of individual transport, as illustrated by the trend shown in Figure 4. A graph was constructed, and a trend line was fitted from the data obtained. It can be clearly seen that the number of kilometers per inhabitant tends to decrease, the formula for which is described by the equation below: For Debrecen's public transport, we have been provided with the runs per capita for the period 2010-2020.

$$y = -0{,}266x + 50{,}668$$

$$R^2 = 0{,}365$$

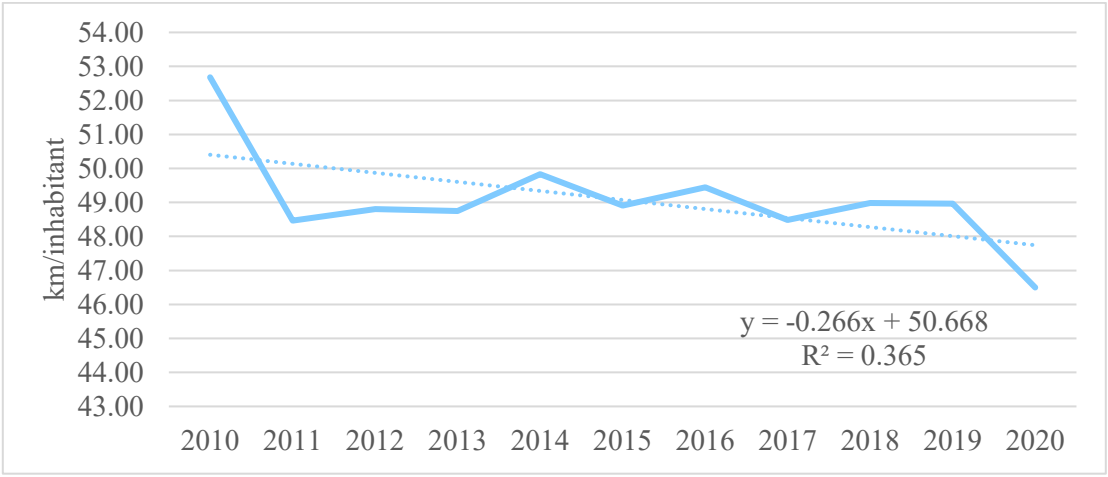

Figure 4: Public transport run per capita for 2010-2020.

Source: own calculation based on DKV data, 2022

It is important to note that the data is available up to 2020, so you can already see the initial extent of the decline caused by the crown tax, but not yet 2021, which was a further decline.

Based on the in-depth interview results, transport planners see three main factors to consider when choosing public transport over private transport. These are the service price, the quality of the journey, and the journey time.

In terms of prices, it can be concluded that, in general, the use of public transport is competitive with the use of private cars, even for shorter or longer distances and periods. Passengers do not have to bear the costs of investment, maintenance, upkeep, insurance, taxes, and parking, nor the negative effects of vehicle deterioration. When using a car, it is necessary to consider the availability of parking spaces and the traffic or access restrictions that are increasingly common in today's cities. However, alternatives such as car-sharing, cycling, micro-mobility, and even walking, available at a similar low cost to public transport, may also be an option.

The second area is comfort. Nowadays, public transport vehicles generally have the same comfort features as cars, such as air-conditioned passenger compartments, heating systems, and safety systems. In addition to these, free Wi-Fi, comfortable, larger spaces, accessibility, and easy boarding and alighting are also features of this mode of transport. Other advantages include the fact that we are not driving the vehicle, so we can have time to work, study, relax, socialize, meet people, and enjoy our surroundings during the journey. Public transport operators constantly focus on providing these conveniences, making the journey more enjoyable and improving service levels. Of course, we also have to consider the need to adapt to timetables and networks, the time and effort involved in getting to stops, and the presence and behavior of other passengers.

In addition to the above, the third significant factor is the time needed to achieve the goal we have set and the predictability of that time. Public transport can offer a good alternative to individual transport in most cases. This requires a timetable with an appropriate frequency and a route and road network that puts public transport better than individual transport. These include track-based, underground or overground solutions, traffic light systems favoring public transport, and bus lanes. In many cities, downtown, residential, or business areas are not accessible by car but only by foot or public transport. In terms of journey times, it is essential to ensure punctuality, predictability of journeys, the availability of transfers and reduced waiting times, and to be able to monitor when the vehicle is due to arrive, whether it is late, and what transfer and faster access options are available. This requires the development of adequate and real-time passenger information available on multiple platforms.

Discussion

Several researchers (Salih -Younis, 2021, Michel, 2020) agree that smart public transportation has become one of the most important things for developing cities and improving people's quality of life. Public transportation users face many problems, the most important of which is the long wait at the bus station. Our research confirms this, as the questionnaire results show that digital solutions and real-time information are quite important to customers. Researchers agree that individual transport is becoming more common and that the growing choice of transport modes is also working against public transport. Options include cars, car-sharing, bike-sharing, e-scooters, and e-bike services, to name but a few. This is supported by our in-depth interviews and the trend in kilometres per capita. There was a significant change in the initial decrease due to COVID when the decrease was even more significant. At the same time, the researchers agree that with the rise in environmental awareness and the increase in traffic caused by individual transport, there is an apparent demand for public transport in larger cities. Our questionnaire research also confirms this, showing that certain factors, such as faster journey times and digitalization, would make public transport more attractive to many travellers. Researchers also came to the same conclusion in a study published by the American Public Transportation Association (APTA) in 2019. Americans now have many ways to travel—bike-share, car-sharing, and ride-hailing, just to name a few—but 77% view public transit as the backbone of a lifestyle with many mobility choices. Nearly 70% of Americans favor increased federal support for public transportation. Notably, while only 50% report having access to frequent public transportation, most say they would use it if it were available. Two-thirds of Millennials say they own a car more because they need one than they enjoy owning one. Half of Americans and two-thirds of Millennials say they would be more likely to use public transportation if it was more convenient and accessible. The evidence is clear that public transportation is politically popular and has high economic returns (APTA, 2019).

Digitalization is one of the pillars of Smart City concepts, which started even before the pandemic, but the pandemic has greatly accelerated them. A July 2020 survey of 899 corporate executives conducted by McKinsey concluded that "companies have accelerated the digitization of their customer and supply-chain interactions and their internal operations by three to four years. Moreover, the share of digital or digitally enabled products in their portfolios has accelerated by a shocking seven years." If we have learned anything since the beginning of the pandemic, our daily life patterns and the institutions where we work are more adaptable than we would have ever anticipated (McKinsey, 2021).

In the EU, the Digital Economy and Society Index (DESI) has been an essential tool for measurement and monitoring since 2014. In 2021, the cardinal indicators of the DESI index were aligned with the 2030 Digital Compass targets, which have four key areas: digitally skilled population, secure and sustainable digital infrastructures, the digital transformation of businesses, and the digitalization public services. As Kovács and Bittner (2022) examined the differences in the digitization of public services between the Member States based on the DESI 2022 and concluded that there is a slight convergence between the EU-27 Member States in the period 2016-2021 for the main indicator DESI_4, but that there are significant differences between the Member States. The same can be said for the digitalization of public transport. The European Commission announced the 'Sustainable and Smart Mobility Strategy' This strategy lays the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. This strategy can make a significant contribution to reducing disparities between the Member States and to making public transport more popular again.

Implications for Practice

There are several areas where this research could be of practical use. Firstly, the exploration of the context in which the digital switchover of public transport has been processed may draw the attention of transport planners to several areas that warrant investigation.

On the other hand, the rise of individual transport harms several factors in cities. These include increased traffic, which leads to increased pollution, noise, and air quality, and adverse effects on journey times due to congestion, which harms the psyche and, therefore, the health of passengers. Therefore, it is essential to know the factors that make public transport more popular. In our research, we examined the impact of 20 factors, the results of which can guide policymakers in determining development directions. Last but not least, the consumer needs for public transport have been assessed, which, in addition to allowing us to understand them, also allows us to assess the expectations and experiences of operators using both sides of the SERVQUAL model. This research was carried out among public transport users in Debrecen, the second-largest city in Hungary, and identified the areas most in need of improvement, but due to the limitations of this publication, this was only partially present.

Limitations

The order and weight of the individual factors influencing transport decisions vary from one individual to another and may also be influenced by cultural and social habits, regional conditions, and opportunities. In the case of the questionnaire on expectations of public transport, the sample is not representative and local characteristics may differ significantly from country to country or even from area to area, so the results of the research are not necessarily suitable for drawing general conclusions. In addition, the digital switchover can only be achieved in a region if the basic infrastructure (mobile internet coverage, use of smart devices) is in place. Furthermore, the attitudes of different cultures towards the digital world are essential. As we have seen in the present survey, the use of self-driving buses was not an attractive factor, which may be due to a general lack of acceptance of the technology, as self-driving road vehicles are not yet widespread in the country, or attitudes towards human-oriented culture. In contrast, in other cultures where digitization is already advanced (e.g., Japan), the attractiveness of this factor would likely be viewed quite differently. Thus, the interpretation of the results requires knowledge of the external environment.

Conclusions

The increasing use of individual transport leads to congestion in cities, contributing to air pollution, increased journey times, and citizens' dissatisfaction. At the end of 2020, the European Commission presented its green, innovative, and affordable mobility plan, the "Sustainable and Smart Mobility Strategy." The strategy's main aims are to reduce transport emissions by 90% by 2050 and improve digitalization based on innovative technologies and methods. To motivate citizens to use public transportation, meeting the passengers' requirements is crucial. At the beginning of 2022, research was carried out in Debrecen on the expectations for public transport. The results of both the questionnaire and the in-depth interviews clearly showed that a significant proportion of residents have turned to private transport. Among those surveyed, only 33% used public transport. However, it also shows that, in line with other American and European studies, a significant proportion of passengers would switch to public transport if transport companies improved certain factors. According to the responses to the questionnaire, the three most important factors that would facilitate a switch to public transport are faster journey time, express services, and real-time information system availability. The survey data shows a trend toward people wanting to access information faster and faster and plan and manage their travel more flexibly and efficiently. This requires public transport operators to work together at inter-and intra-local levels, regardless of whether the state or the city provides the public service. It is proposed to build and operate a unified passenger information system covering the whole country or region, bringing together all the transport services. This would simplify the planning and implementation of journeys, not only for the public but also for operators. The coordination of long-distance, suburban and local timetables will be easier to achieve, allowing operators to attract more passengers and reduce costs.

One of the best platforms to provide the expected quality of passenger information is an application accessible through all operating systems that manage services in a simple, passenger-friendly way in a single interface. By developing applications that provide a complex service, more passengers can be reached; real-time passenger information can be complemented by the possibility to buy travel entitlements, which can increase the satisfaction of public transport users and attract new passengers.

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