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Article

On-demand transportation in promoting sustainable urban mobility: A systematic literature review and survey analysis

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Abstract: The concept of sustainable urban mobility has gained increasing attention in recent years due to the challenges posed by rapid urbanization and environmental degradation. The objective of this study is to explore the role of on-demand transportation in promoting sustainable urban mobility, incorporating insights from customer interests and demands through survey analysis. To fulfill this objective, a mixed-methods approach was employed, combining a systematic literature review with survey analysis of customer interests and demands regarding on-demand transportation services. This study combines a systematic literature review and a targeted survey to provide a comprehensive analysis of sustainable urban mobility, addressing gaps in understanding customer preferences alongside technological and financial considerations. The literature review encompassed various aspects including technological advancements, regulatory frameworks, user preferences, and environmental impacts. The survey analysis involved collecting data on customer preferences, satisfaction levels, and suggestions for improving on-demand transportation services. The findings of the study revealed significant insights into customer interests and demands regarding on-demand transportation services. Analysis of survey data indicated that factors such as convenience, affordability, reliability, and environmental sustainability were key considerations for customers when choosing on-demand transportation options. Additionally, the survey identified specific areas for improvement, including service coverage, accessibility, and integration with existing transportation networks. By providing flexible, efficient, and environmentally friendly transportation options, on-demand services have the potential to reduce congestions, improve air quality, and enhance overall urban livability.

Keywords: on-demand transportation; sustainable urban mobility; urban transportation; mobility services; transportation integration

1. Introduction

Sustainability has emerged as a critical objective across various markets, becoming especially prominent in urban mobility systems. One significant development in this area is the rise of on-demand transportation services, which tailor solutions to meet user-specific needs. These services offer flexible and efficient transportation options that have the potential to mitigate the harmful emissions often associated with urbanization. This study explores the role of on-demand transportation in promoting sustainable urban mobility, with a focus on reducing environmental impacts while enhancing service efficiency.

To address these challenges, this research incorporates a systematic review of literature sourced from the Scopus database, framing on-demand transportation and community-based urban mobility services within the broader context of Smart City concepts. Smart Cities leverage innovative technologies to enhance urban services

while prioritizing economic, social, and environmental sustainability. While most studies on this topic often focus on technical aspects, this research emphasizes the importance of economic and service development considerations.

This research integrates findings from a systematic literature review (SLR) and a survey analysis to identify both theoretical insights and real-world preferences for on-demand transportation systems. The dual approach aims to bridge the gap between academic research and consumer behavior analysis, ensuring practical applicability.

The primary goal of this research is to determine the characteristics that make on-demand services both profitable and sustainable. In this context, the research seeks to answer the following key questions:

RQ1: What characteristics must a community-based transportation service have to be considered sustainable?

RQ2: What service features should an on-demand public transportation service include to gain popularity from the consumer's perspective?

Using a combination of systematic literature review and survey analysis of 140 respondents, this study aims to uncover the key factors that contribute to the success of on-demand transportation systems. The PRISMA and PEO methodologies guided the literature review, while descriptive statistical methods were used to evaluate the survey. Through this approach, the research investigates the most suitable business models and crucial factors for service development, specifically identifying the preferences and behaviors of potential users. Addressing these aspects is essential for designing an optimal service, especially from a profitability perspective, a gap previously noted in the literature.

While the survey focuses on university students, its findings provide preliminary insights that future research should expand to include working professionals, older adults, and rural populations for broader applicability.

2. Materials and methods

A part of this study utilizes the Systematic Literature Review (SLR) methodology to explore the sustainability of on-demand public transportation. An SLR involves an in-depth search for relevant studies on a specific topic. Identified studies are evaluated and synthesized according to predefined, explicit methods. The goal of an SLR is to gather all empirical evidence that helps answer a set of pre-established research questions, and then draw conclusions (Briner and Denyer, 2012; Denyer and Tranfield, 2009; Tranfield et al., 2003). This review adopts a rapid and simplified systematic review method, narrowing the search strategy and limiting the number of databases. Restrictions include the number of databases consulted, limiting the time frame for article searches, skipping manual review of reference lists, and limiting the number of reviewers involved in defining criteria, data extraction, and quality assessment (Reynen et al., 2018; Hamel et al., 2021).

The systematic review focused on selecting keywords closely related to the themes of sustainability, financial profitability, and efficiency in transportation and on-demand services. The selected keywords were: Public transportation, Urban transportation, Urban mobility, Smart City, On-demand transportation (with multiple English synonyms), Digitalization, Development, Sustainability, Efficiency,

Profitability, Finance, Optimization. These keywords were sorted and categorized according to the PEO (Population, Exposure, Outcome) framework into three main categories:

- Population: What is the broadest scope of the research focus?
- Exposure: What criteria are most relevant to the selected population?
- Outcome: What is the narrow focus or core of the investigation?

For this study, the population refers to public and urban transportation, exposure involves criteria that influence the topic's distribution within the population, and the outcome focuses on identifying the main aspects of interest. A combination of 3–4 keywords was used for screening the literature, aiming to locate and analyze the most relevant sources within the field. The initial filtering stage involved choosing the database, which, in this case, was exclusively the Scopus database.

Table 1. SLR list of criteria.

Population	Exposure	Outcome
Public transportation	On-demand transportation	Sustainability
Urban transportation	On-demand	Efficiency
Urban mobility	Digitalization	Profitability
Smart City	Development	Finance
Optimization		

In the initial phase, using keyword filtering alone, the Scopus database yielded a total of 6986 studies. Applying additional criteria reduced the count to only 183 papers. This drastic narrowing (just 2.6% of the original number) highlights the significant impact of the filtering process. It also indicates that research on this topic is scarce, especially within the chosen focus. Additional elements were filtered out after evaluating titles and abstracts. The remaining exclusion steps and related statistics are presented in further data tables.

Table 2. Detailed breakdown of exclusion and inclusion criteria.

Criteria applied	No. of studies
Keyword combination (K1)	6986
Published in the past 10 years; 2014–2024, January (K2)	6390
Relevant subject matter (K3)	713
Document type (K4)	540
English language (K5)	531
Source restriction to journals and conference proceedings (K6)	528
Open Access (K7)	183

The second part of the research was conducted with a survey analysis based on responses from 140 participants. In terms of gender distribution, 81 respondents were male and 59 were female, representing 58% male and 42% female participants. This indicates a notable predominance of male respondents in the sample.

The study was carried out among students at Széchenyi University, and the age distribution shows that 139 of the 140 respondents fell within the 18–25 age category.

The research categorized respondents into four age groups: Under 18, 18–25, 26–65, and over 65. Only one respondent was above the age of 65, which makes the results particularly relevant to young adults and university students, who are potentially one of the largest user groups for public transportation services.

The majority of respondents (97%) were students, which aligns with the context of the survey being conducted among university students. In addition to their studies, most of the respondents also reported having a job, while only one person identified themselves as an entrepreneur.

3. Results

When reviewing the publication dates of the studies, it becomes apparent that more articles have been published closer to the present, indicating growing interest in the field.

3.1. Bibliometric analysis

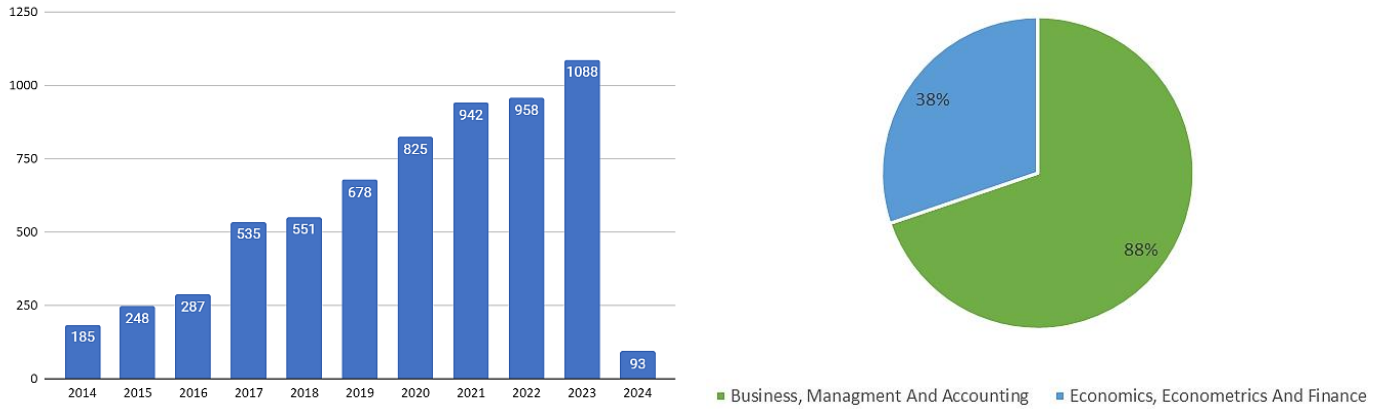
Of the 183 studies initially selected, 93 met the criteria for in-depth analysis based on their relevance to financial sustainability, consumer behavior, and technological integration. Studies not meeting these criteria, such as purely technical papers, were excluded. AI/ML-focused papers were excluded as their primary emphasis was on technical optimization, such as fleet rebalancing, which fell outside the financial and operational focus of this study. These aspects are acknowledged as important but merit separate investigation.

Of the 93 selected studies, two main categories emerged. One category focuses on the smart city concept in various socio-economic contexts, often with either a technical or economic perspective. The other category, and the primary focus of this research, examines these services and concepts through a purely financial and market-driven lens. Only 11 studies in this category were deemed relevant based on their titles and abstracts. A distinct research gap becomes evident: While many studies have been conducted annually on technical aspects like energy use and engineering, far fewer explore the financial implications of on-demand transportation. The selected articles were published across 11 different journals, with no overlap. These journals include: Research in Transportation Business and Management, Small Business Economics, Financial Innovation, Journal of Cleaner Production, and Sustainable Technology and Entrepreneurship. Of the 11 studies, 55% were published in Q1 journals, 18% in Q2, while three papers were either not ranked or had invalid entries on Scimago.

These studies were published over the past seven years, with the oldest dating back to 2017. The most cited study had only 63 citations, and this primarily focused on socio-economic aspects, not financial considerations. The citation counts suggest that the more financially and economically focused a study is, the fewer citations it garners, even though these studies are predominantly published in high-impact journals.

The initial dataset of nearly 7000 studies showed the highest number of publications (1088) in 2023. After applying all criteria, the final dataset shrank significantly, though the trend remained clear. The 2024 data reflect fewer studies simply because the filtering occurred in the first days of the year. Throughout the

examined period, 6390 studies met the inclusion criteria, comprising 91% of the filtered dataset. Two filtering categories related to subject matter were used as inclusion factors. Their distribution is illustrated below:



(**a**) (**b**)

Figure 1. (a) Number of studies published annually over the past 10 years; **(b)** scientific discliplines of the final.

The vast majority of excluded studies focused on technical fields, such as artificial intelligence or big data applications, even though relevant keywords were used. Additionally, tourism-related papers were often excluded as irrelevant to the current research. Interestingly, despite the large sample size, there was little duplication across sources. A wide variety of journals are represented, and no discernable trends emerged.

For instance, zonal systems have been successfully implemented in cities like Helsinki, where on-demand shuttles operate within designated zones, complementing traditional public transport. These services reduce last-mile gaps and improve overall connectivity. Integrating on-demand systems with traditional public transport poses challenges such as fare alignment, scheduling compatibility, and infrastructure requirements. Potential solutions include unified digital platforms for ticketing and real-time route optimization.

3.2. Qualitative content analysis

A 2014 United Nations report, which discussed global urbanization forecasts, stated that over half the world's population now lives in urban areas, and by 2050, approximately 2.5 billion people are expected to move to cities or their surrounding areas (Sun et al., 2016). The increasing urban population has affected the living conditions of residents, contributing to traffic congestion, greenhouse gas emissions, carbon dioxide emissions, and noise pollution. These challenges have brought the Smart City concept into focus, as a potential solution to such environmental issues (Bokolo, 2022).

A Smart City typically uses innovative technologies such as Information and Communication Technologies (ICT) and new urban infrastructures to improve service quality and, as a result, enhance the quality of life for its residents (Bokolo, 2023a). In other words, a Smart City is a complex system where human and social aspects work closely together, supported by digital technologies aimed at optimizing natural

resource use (Orecchini et al., 2018; Rahman et al., 2019). However, financing and implementing these digital solutions can be difficult and often unsuccessful. Sometimes, cities are forced to buy solutions that do not integrate with existing systems because their internal infrastructures differ too much (Bokolo, 2023b). In a study examining cities with different social and geographical characteristics, one respondent from Helsingborg noted, "It is often impossible to transfer existing digital solutions to a new context within the city. This is because many of our information systems are too different" (Perätalo et al., 2023b).

Smart Mobility, a key component of sustainable road transportation, addresses the increase in vehicle numbers, which leads to higher noise levels, air pollution, and traffic congestion, negatively impacting the environment and worsening air quality, while also contributing to climate change (Assaf and Khanji, 2019; Bokolo, 2020). Therefore, conscious urban planning and service provision will become increasingly important in the future to achieve international and regional sustainability goals. For a service to remain environmentally sustainable in the long term, it must first achieve economic sustainability. A well-designed business model can enhance competitive advantages and create long-term success (Wirtz et al., 2016).

However, it is important to place these new innovative services within a specific context, particularly within the Smart City concept, to ensure they fit within the city's business model and infrastructure (Perätalo et al., 2023). Once the service has been aligned with the broader framework, attention must be given to its operational aspects. Different options are available when developing business models. Bokolo (2023a) identified four main categories of business models, which can be interpreted in the context of this study as follows:

- Business to Business (B2B): In this model, companies provide products or services to other companies, with the end user being a legal entity. In this study, an example would be a bus company offering transportation services to a company's employees.
- Business to Consumer (B2C): In this model, businesses provide products or services to individual consumers, typically households. Most people interact with this model, where companies directly offer products or services to the public. In this study, the current public transportation providers serve as an example.
- Peer to Peer (P2P): In this model, individuals provide services directly to one another as equal market participants. Within the Smart City context, this model is often seen in vehicle rental or sharing services. Currently, initiatives based on sharing are common examples of this model.
- Consumer to Business to Consumer (C2B2C): This unique service model is prevalent in some industries and can be socially or financially beneficial. A well-known example is eBay, where the company acts as a middleman between consumers. In this study, Uber can be viewed as a C2B2C model, where individuals provide rides while the company facilitates the transaction. There are limited options for separating usability in a transport service. Systems operating with completely fixed routes and fixed stops, which can already be observed in the case of already existing services, are one possibility.

There are limited options for segregating services by location in a transportation service. Existing services often operate with fixed routes and stops as one option. In contrast, a zonal solution, which is not yet widely implemented for on-demand services, allows pick-up and drop-off points within larger areas, rather than limiting them to specific stops. A third, and potentially the most convenient option for consumers, is a fully dynamic service that operates like a taxi, picking up and dropping off passengers based on individual needs.

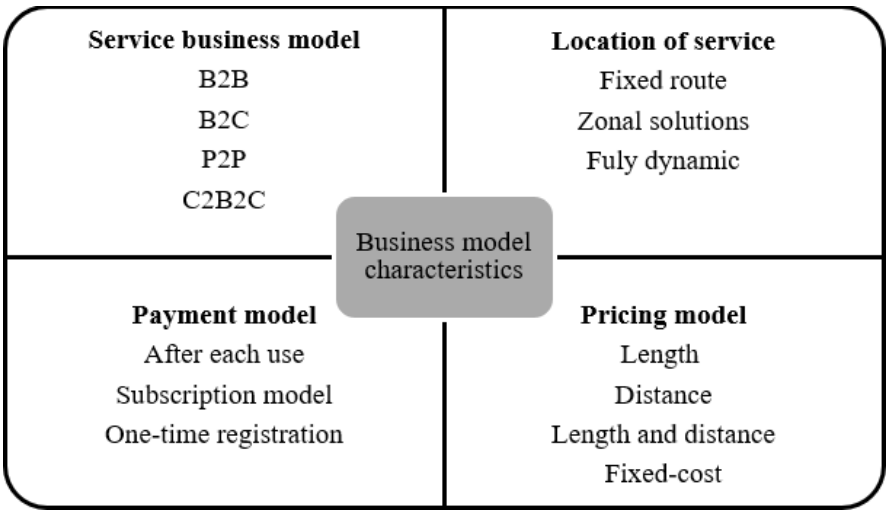


Figure 2. Business model characteristics (based on Bokolo, 2023a).

In terms of payment models, several options exist for these services. The pay-as-you-go model charges the user after each use. This is already a common practice in transportation services, including taxis and various public transport services (Münzel et al., 2019). Another option is a subscription model, similar to a periodic pass, which provides recurring access to services at a lower price as an incentive for regular usage. This is a common practice among urban public transport providers (García et al., 2019). One more model worth mentioning is the one-time registration model. However, this study finds this model less relevant, as it is typically used by services providing access to smaller vehicles, such as e-bikes or scooters, requiring an initial, larger payment, followed by several smaller fees. A large-scale, urban public transportation service that aims to be economically sustainable—or at least less unsustainable—would require unrealistically high fees from consumers if this model were applied.

The chosen payment model is closely tied to the pricing model. For transportation services, pricing can be based on several factors. Time-based pricing calculates the fare based on the length of time the vehicle is used. This model works well for smaller-scale individual mobility services (Georgakis et al., 2020). Distance-based pricing charges the user based on the distance traveled. These two factors can also be combined into a time-and-distance pricing model. Additionally, fixed-cost pricing is a simple, straightforward model.

3.3. Transportation habits and preferences analysis

This section examines the attitudes and habits of respondents, which will later allow for clustering, cross-tabulation analysis, and deeper statistical insights.

3.3.1. Most commonly used transportation methods in daily life

Today, consumers have many transportation options to choose from. The distribution of these choices is illustrated in the following graph, showing the most common and frequently used modes of transportation among respondents.

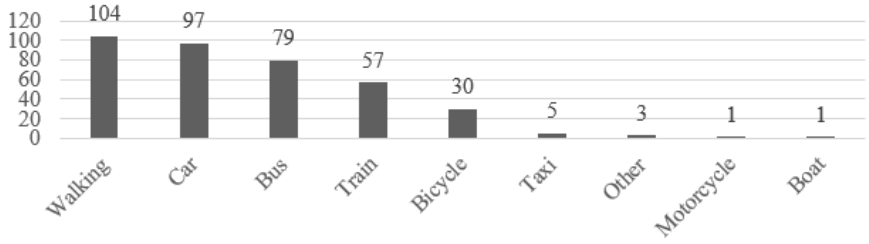


Figure 3. Most commonly used modes of transportation.

The responses can be divided into three main categories. Walking was identified as the most common and frequently used mode of transportation in daily life. The second most frequently used method was traveling by car. In a previous study, these two results were reversed. The shift may be attributed to the fact that fewer young adults and university students own cars or use them regularly during the weekdays. The third most frequently used modes of transportation were buses, followed by trains and other forms of public transportation. The "other" category includes modes such as scooters and skateboards, which are less common but still relevant in urban mobility.While public transportation was popular and not far behind the first two groups, there is still room for growth and attracting more users.

However, one key observation that is not visible on the graph is the respondents' feedback on carsharing and similar on-demand transportation methods, which are popular abroad. None of the respondents reported using these as frequent transportation options. This suggests that such services are largely unfamiliar to the sample, and introducing these options would require significant effort and pose some risk due to the unfamiliarity factor.

3.3.2. Frequency of transportation methods used

The following table examines respondents' daily transportation habits. The goal of this analysis was to assess how respondents use public transportation or other modes of transportation in their everyday lives. It was also important to assess habits beyond just public transportation, so the survey included several other transportation methods used in daily life.

As shown in the previous figure, walking was the most frequently used daily transportation mode. Interestingly, traditional public transportation modes, such as buses and trains, were used either daily or weekly. The frequency of bus usage was only slightly lower than car usage when examining daily habits. However, on-demand transportation options like carsharing were found to be currently underutilized.

A new, market-based transportation service could expect weekly use from roughly half of the respondents. Among the large number of daily walkers, there is a potential to attract new users, just as there is among car users, where offering a more attractive alternative could entice those who currently use their cars on a weekly basis.

Table 3. Frequency of transportation methods used.

Frequency	Walking	Bicycle	Motorcycle	Car	Taxi	Train	Bus	Other Public Transport	Carsharing
Daily	111	6	1	56	0	9	47	1	1
Weekly	22	23	2	67	3	44	31	4	4
Monthly	3	41	6	13	10	22	18	7	4
A few times a year	1	46	11	2	62	52	32	58	10
Never	3	24	120	2	65	13	12	70	121

3.3.3. Transportation habits based on destination

The study also examined the modes of transportation respondents used to reach specific daily destinations. Four main destinations were identified: School, work, shopping, and other travel purposes. Transportation to school is an important aspect to consider for any transportation service, as this age group forms one of the largest user bases. The demographic breakdown of the sample clearly reflects this.

The same trend continues here. Respondents' transportation habits can be grouped into three main categories: Walking, bus, and car, in that order. Public transportation, especially non-traditional options, was not widely used. Attracting school-aged users will be crucial for the success and economic sustainability of a market-based transportation service.

Respondents reported using different modes of transportation depending on their destination. A clear trend emerges, showing that regardless of the purpose, cars are popular and frequently used. However, the choice of transportation method is highly individualized and depends on several factors.

3.3.4. Transportation location

None of the respondents indicated that they do not travel at all, highlighting that transportation is integral to everyday life. Those unable to participate in the transportation system risk being excluded from society. Transportation and access to proper services are becoming increasingly important.

The majority of respondents identified urban transportation as the most common location for their travel. Due to ongoing urbanization, mobility demands have shifted, and intra-city transportation is becoming more and more important. Improving urban transportation benefits both consumers and service providers. This study also explores the possibilities for on-demand services within the city.

An on-demand service would likely find the most users in urban settings. Several solutions exist to improve urban public transportation, including systems that operate independently or integrate with traditional public transportation. Improving urban transportation, while considering environmental and well-being factors, remains a critical topic.

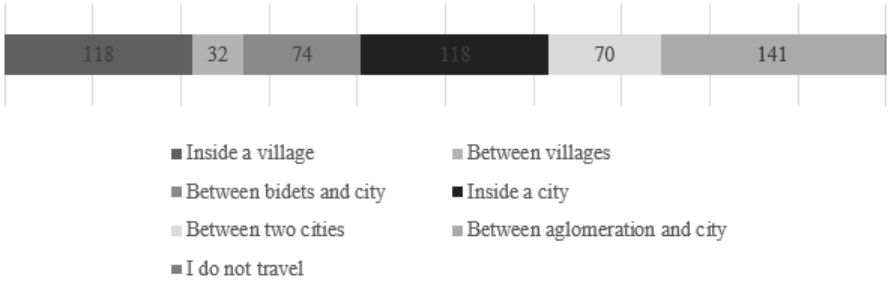


Figure 4. Most common transportation locations.

3.3.5. Analysis of travel distance

The following two figures and their findings are closely connected to the previous one.

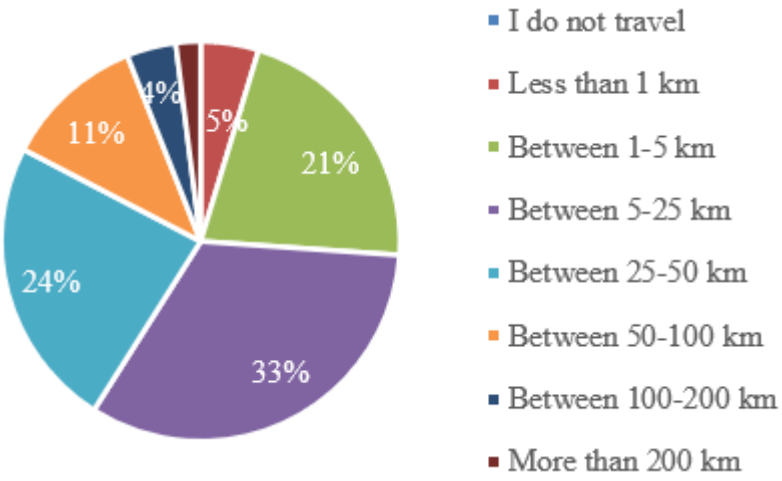


Figure 5. Average daily distance traveled.

The travel location heavily influences the average distance traveled each day, which, in this case, falls between 5 and 25 km, fitting within the framework of urban transportation.

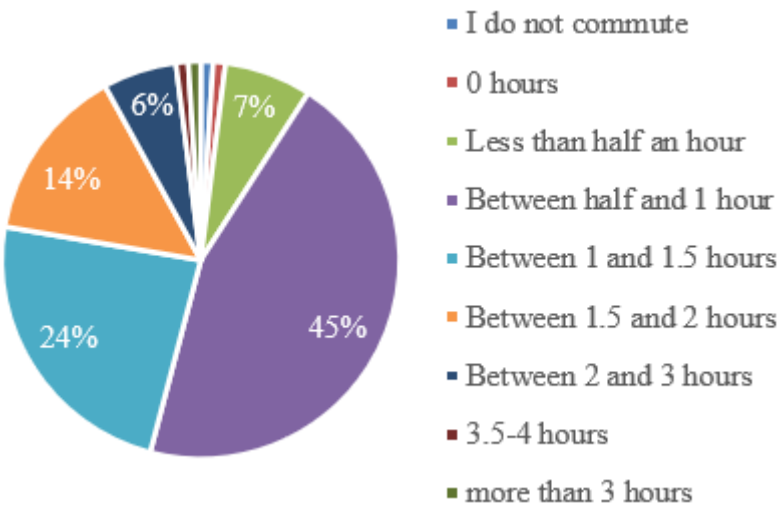


Figure 6. Average time spent traveling daily.

Respondents reported traveling between 0.5 h and 1 h daily. These insights are particularly important for the next phase of the study, where the goal is to create a viable financial model for the service.

3.3.6. Optimized business model survey

The following figure examines how respondents perceive the sustainability of the current transportation system. Increasingly, consumers are adopting a "conscious consumer" mindset, where the environmental impact of a product or service influences their choices. Perceived sustainability in this case refers to respondents' subjective assessment of how environmentally and economically sustainable they find current transportation systems, based on the survey's introductory description.The results show that a significant portion of consumers consider the current system to be moderately sustainable, indicating room for improvement. There is also potential to influence consumer opinions in a more positive direction.

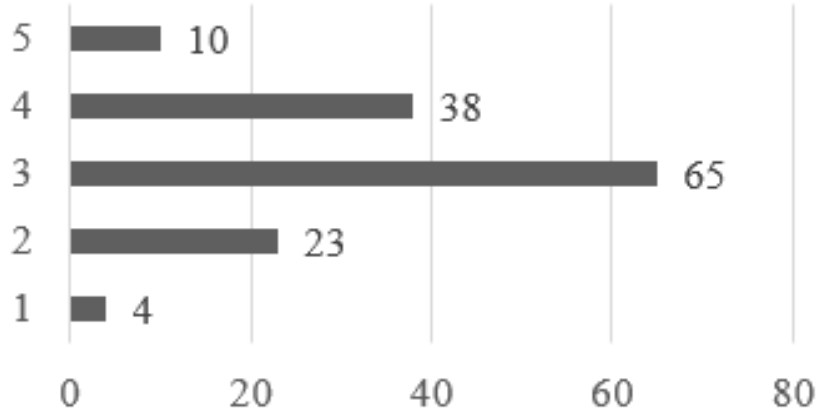


Figure 7. Perceived sustainability of the current transportation model.

This part of the research is perhaps the most important and also one of the most critical from an evaluation standpoint. Our current public transportation system has not changed significantly over the past 10, 20, or even 30 years. The implementation of innovations made possible by digitalization and Industry 4.0 has only just begun. For this reason, it is challenging to consider our public transportation system as an opportunity for innovation, but in the modern era, a new perspective is becoming increasingly necessary. This new perspective introduces on-demand services, whose key advantages are flexibility and ease of use. The remainder of the study aims to define a specific business model that can first achieve economic sustainability and, through that, environmental and social sustainability.

Three operational models were identified. Globally, there are good practices and examples of on-demand public transportation services, but each tends to serve a narrow, well-defined target audience. Respondents were presented with three options, ranging from a fully dynamic taxi-like model to the rigid, fixed-route system that is currently in use. The third option, a middle ground, is a zone-based system that combines the benefits of both approaches, offering social usability with a more flexible framework.

Zonal systems aim to combine the flexibility of on-demand transportation with the reliability of traditional public transport through three key stages. First, the user

requests are collected within the predefined zones via a digital platform, optimizing coverage and reducing travel time. Next, the advanced algorithms dynamically generate efficient routes, considering both the real-time traffic parameters and the user preferences, to minimize delays and environmental impacts. Finally, the system connects to the major public transport hubs, enabling seamless transitions to fixed-route networks for first-mile and last-mile connectivity. This hybrid approach enhances accessibility, reduces redundancies, and offers user-centric, sustainable urban mobility.

When examining public transportation, it became clear that the fully dynamic taxi-like service was not popular with respondents. Twenty-seven percent rejected the idea entirely, while only 18% expressed support. The remaining 54% were unsure. The fact that negative responses outweighed positive ones suggests that those who were undecided might lean toward rejecting this model.

In contrast, the "floating" system, which has not yet been introduced in Hungary, elicited the greatest uncertainty. Nearly 60% of respondents fell into the "Maybe I would use it" category. This likely reflects the unfamiliarity of such services. However, 24% of respondents expressed positive views, compared to only 16% negative responses. This indicates that respondents were more open to this possibility, though the unfamiliarity of the service may have influenced their responses.

Finally, the most positive responses were given to the current system or a system similar to it. Half of the respondents were fully supportive of a fixed-route service, likely because they already use public transportation and are familiar with this system. This suggests that consumers do not perceive the rigidity of fixed routes and schedules as a drawback, but rather as a source of reliability. It also indicates that no radical overhaul or innovation is required in the service and operational model. Consumers' unfamiliarity with certain elements could lead to negative reactions, which may hinder the success of the service. Overall, the current fixed-route system seems to be the most popular operational model, at least for the initial period. However, to gain a competitive edge, the existing system's weaknesses should be optimized.

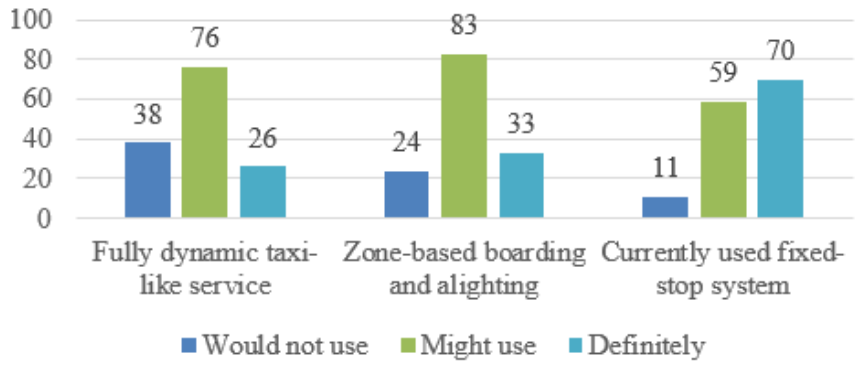


Figure 8. Comparison of public transportation operational models: Fixed-route, floating-zone, and fully dynamic systems.

When establishing the business model, it is important to consider the type of service provider. In some markets, this is clear-cut: A business with legal entity status. However, in this market, alternative service provider models are also in operation, as

noted in the literature review. This study considered three relevant possibilities: A traditional business model, a direct marketplace model between private individuals, and a business-regulated private individual model, such as Uber.

- First, the service provided by a business (the B2C model) was the most accepted by respondents. More than half of the respondents indicated that they would use a service from a company.
- Second, in terms of a potential carsharing service, respondents were not receptive to the C2C model. This was the only option that received a significantly high number of negative responses, as well as a great deal of uncertainty. This can likely be attributed to the growing distrust between citizens.
- The third model, C2B2C, which is familiar in Hungary through transportation services like Uber, was not far behind the B2C model in terms of support.

It can be concluded that both the B2C and C2B2C models are viable. The decision between these two options should be based on management and financial strategy.

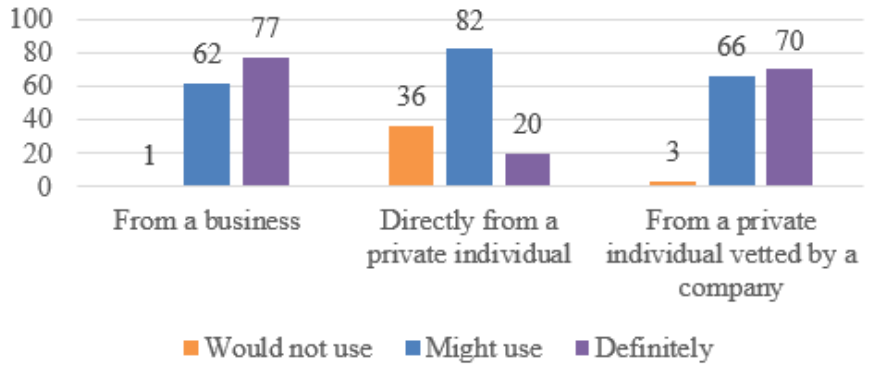


Figure 9. Preferences for service provider types in on-demand transportation: Business-to-consumer (B2C), peer-to-peer (P2P), and consumer-to-business-to-consumer (C2B2C) models.

The table below measures the importance of various features of public transportation services, based on responses from the participants. The participants rated their preferences on a five-point importance scale.

Table 4. Preferences for urban public transportation features.

Importance level	Not important	Slightly important	Moderately important	Important	Very important
Comfort	3	12	48	47	30
Price	0	4	16	53	67
Travel time	1	3	18	48	70
Waiting time	0	2	21	49	68
Proximity to stops	3	6	44	62	25
Availability of travel info	2	6	34	49	49
Privacy	6	24	51	36	23
Ease of use	3	3	26	61	47
Vehicle size	6	30	51	36	15

The respondents were also asked to choose from three different payment models, all of which are widely used today. The options included a one-time, larger annual subscription, pay-as-you-go, and a monthly pass. Most respondents preferred the monthly pass model, which also tends to be more beneficial from the provider's perspective. As seen with gym memberships, not all pass holders use the service fully, which can make this option more cost-effective for both parties.

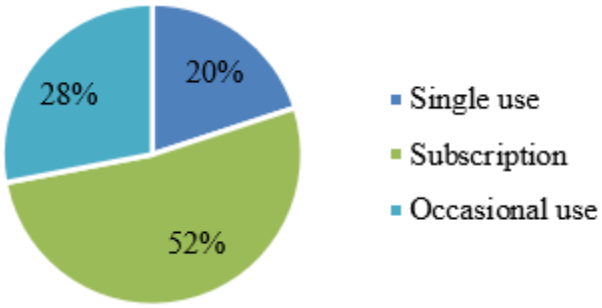


Figure 10. Examination of payment models.

In addition to the payment model, the pricing model is one of the most critical factors. Several factors could be the basis for pricing in such a service. However, the majority of respondents indicated that considering both time and distance together would be the most reasonable. Although this would result in greater variability, standardization would be necessary, and a tiered pricing system based on time and distance would be the most logical approach.

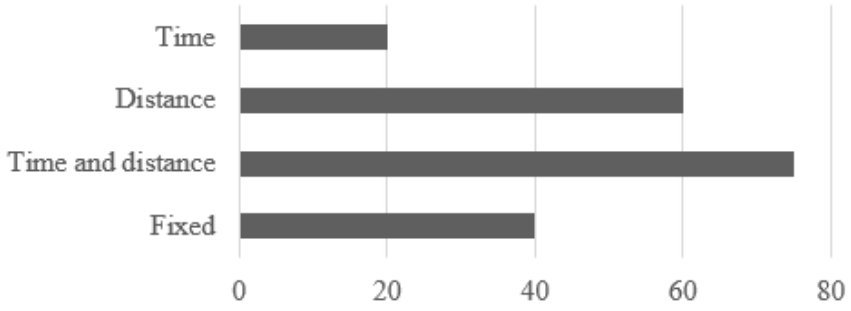


Figure 11. Examination of pricing models.

Pricing is a complex process influenced by many factors. However, if the service is based on a monthly pass with a tiered system, it is important to know the maximum amount consumers are willing to pay. In this case, the maximum monthly payment would be cca. EUR 10.1 (HUF 4000), which aligns with the prices of current monthly public transportation passes.

The findings from this part of the research do not suggest a need for major innovation or a complete overhaul of the public transportation system. Rather, they support the idea that optimizing existing solutions would be more beneficial. Determining a preference system will help identify areas where the current services fall short. However, exploring the potential for new features is also worthwhile. These features, supported by digitalization, have become increasingly prominent, especially within the Smart City framework.

The most accepted idea was the introduction of an on-demand service that departs based on consumer needs. As seen in **Table 4**, waiting and travel times are important to current consumers. Respondents were open to any innovation that would either reduce travel time or make it more predictable. Digitalization will likely play a significant role in achieving this.

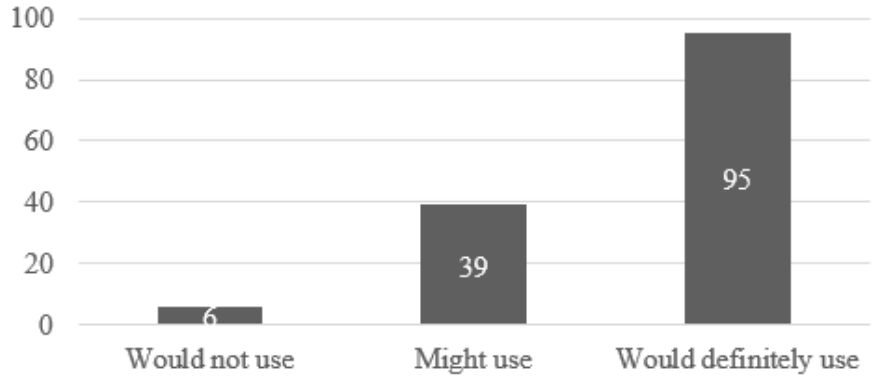


Figure 12. On-demand services based on consumer need.

As indicated in the previous and following figures, any measures that improve predictability and create more transparency for consumers will generate positive feedback. Consumers would be willing to use a service that implements these features. The same applies to real-time journey planning and tracking. Although these services already exist on paper, they are often not implemented effectively. In the future, they will be essential not only for consumers but also for urban planning and transportation sustainability.

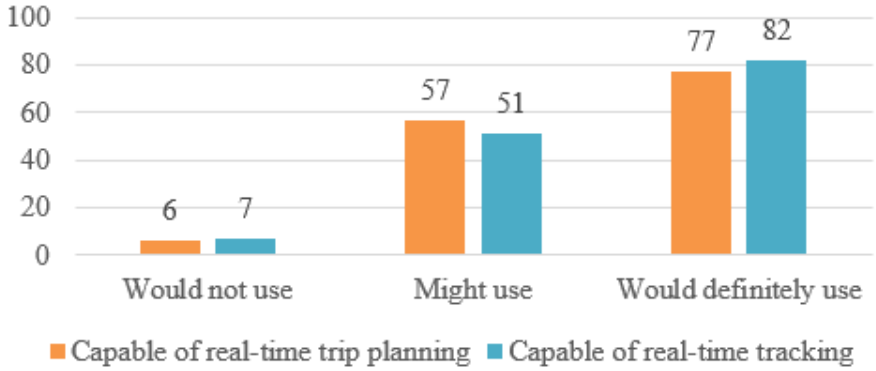


Figure 13. Real-time tracking and journey planning.

Given that this study also examines economic sustainability, we explored the respondents' views on using electric vehicles. The responses were highly positive. In addition to environmental sustainability, electric vehicles could also impact the cost structure of short-range urban mobility services.

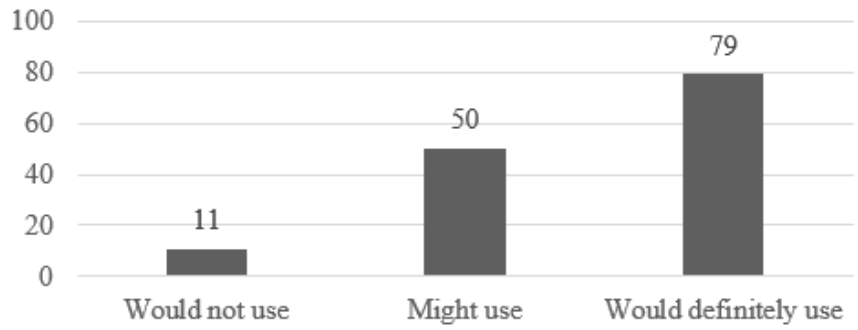


Figure 14. Behaviour towards electric vehicles.

The research has already identified the features that respondents believe the service should have. The primary goal of this study is to examine the applicability of on-demand features, which are represented by a middle-ground zonal system. According to Figure 19, this system should be combined with the fixed characteristics of the traditional system. For example, Uber's drop-off and pick-up zones could be implemented as relatively larger areas, while the routes between them would remain fixed, similar to current public transportation services. Continuous tracking would also allow for route adjustments, reducing travel time when necessary.

These findings suggest that this system alone would not be capable of sustainably serving the entire population. Therefore, the most logical solution would be to design the system as a "feeder" service that works in collaboration with traditional public transportation.

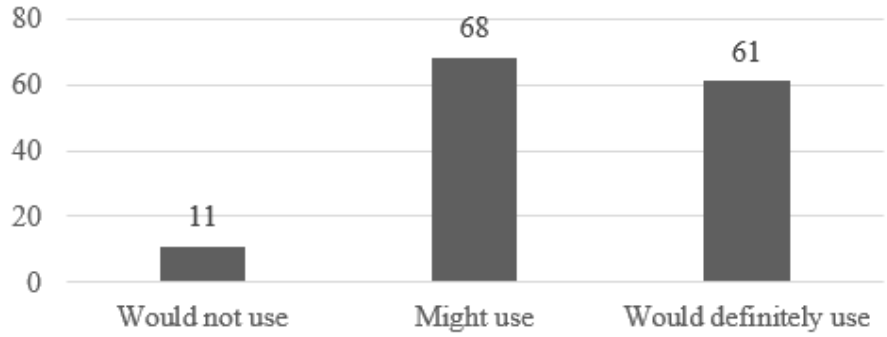


Figure 15. Zone-based system with larger pick-up and drop-off areas than traditional services.

4. Discussion

After analyzing and evaluating the responses, we gained a clearer understanding of what type of business could be successful. Since the entire respondent pool consisted of university students, the needs and opinions of this specific target group were used to identify the following factors.

The first and most important factor to determine is the service's range and area of operation. Based on the responses presented in **Figure 4**, two main options were considered: Intra-city transportation or routes connecting two cities. While this does not fully narrow the scope, the data visualized in **Figures 5** and **6** suggest that the range should be capped at 1–25 km. This implies that each trip should ideally last no

more than 30 min. This distance fits well within the scope of urban transportation or transportation between a city and its suburbs. However, this range can also be applied in other contexts, which will be discussed after the model has been defined.

The primary goal of this study is to assess the market potential of a new service or propose improvements to the current system. The introduction of a new service or the addition of new features could be achieved by leveraging on-demand features, with digitalization serving as the foundation. In terms of operational models, respondents preferred the fixed-stop system currently in use, but they did not reject the possibility of implementing a zonal system, where passengers could access the service over a larger area rather than specific stops. In such a system, digitalization and IoT technologies would play a significant role, with the on-demand concept at its core.

Research Question 1: What characteristics should an on-demand public transportation service have to be sustainable?

- Based on the analysis, a sustainable on-demand service should meet several key criteria:
- The service range should be between 1–25 km, ensuring that trips do not exceed 30 min.
- The service must be integrated with digital and IoT technologies, allowing real-time information sharing and optimization of routes and schedules.
- The payment model should be subscription-based, which 75% of respondents preferred over pay-as-you-go alternatives. These features ensure operational efficiency and meet both environmental and consumer needs, which are essential for sustainability.

Research Question 2: What service characteristics should an on-demand public transportation service have to be popular from the consumer's perspective?

From the consumers' viewpoint, flexibility and ease of use were identified as the most important characteristics. Respondents showed a strong preference for a zonal system, where services can operate across larger areas rather than fixed stops. Additionally, 60% of respondents expressed interest in services that would depart based on consumer demand, offering increased convenience. Other important characteristics included comfort, waiting time, and travel time, all of which were highly rated in the survey. Together, these features indicate that consumers prioritize ease, speed, and flexibility when selecting transportation options.

Another critical consideration is the service provider. Previous examples and practices in the country suggest that using a traditional business-to-consumer (B2C) model is the more established approach. However, the responses also showed support for the consumer-to-business-to-consumer (C2B2C) model, especially when considering modern services like Uber. For this model, however, lobbying and legal factors must be carefully considered. The decision between these operational models depends on the specific characteristics of the service.

One such operational characteristic is the payment model, which could be based on subscriptions, pay-as-you-go, or a larger one-time registration fee. Most respondents preferred a subscription-based service, with an optimal monthly price capped at 4000 HUF. Pricing would need to take several factors into account, with

respondents favoring a combination of time and distance. This implies that a tiered pricing system should be implemented to allow for flexibility in service offerings.

Finally, specific on-demand features that should be implemented include the ability to depart based on consumer demand and the real-time sharing of information. These features, supported by digital and IoT systems, are critical to ensuring the flexibility and convenience that consumers expect from on-demand services.

These findings can guide policymakers in designing flexible urban transport systems. For example, zoning regulations and subsidies could support on-demand services, while collaboration with traditional public transport operators could improve efficiency and accessibility.

The survey results primarily reflect the preferences of university students, a demographic well-suited for assessing the feasibility of on-demand systems. However, future studies should include broader groups to validate these findings and capture diverse transportation needs.

5. Conclusions

Public transportation has not undergone significant changes or innovations in recent decades. However, the effects of urbanization have created a demand for more sustainable urban mobility solutions. This study examined the topic through the lens of sustainable business development, using a systematic literature review and a questionnaire-based statistical analysis. In this context, sustainability was defined as financial sustainability, a less explored topic in the literature surrounding on-demand services.

The literature review positioned this type of service as a component of the Smart City concept, which focuses on sustainable urban planning. Simultaneously, the review highlighted the importance of digitalization and its role as a foundational requirement. Most importantly, these services should be viewed within an ecosystem, rather than as independent market entities. Accordingly, such systems must sometimes operate with unique service development solutions, often collaborating with traditional transportation systems in a symbiotic manner.

The questionnaire results did not indicate a need for radical changes but suggested that optimization and development should focus on both operational and strategic improvements. However, targeting certain niche markets could be worthwhile, as choosing the right model could lead to the development of a sustainable service. The next phase of research will aim to develop this model using simulation capacities and discrete event simulation techniques.

This study offers actionable insights for urban planners, transport operators, and policymakers, advocating for scalable, sustainable on-demand systems. By emphasizing consumer preferences and financial feasibility, it supports strategic decision-making for future urban mobility solutions.

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administration, AS. All authors have read and agreed to the published version of the manuscript.

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