# METHODS TO ESTIMATE URBAN ACCESSIBILITY IN A MEDIUM SIZE CITY. CASE STUDY: IAȘI, ROMANIA

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*This article focuses on the urban transport accessibility estimation, in the context of a study on a multimodal transport model for the city of Iași consisting of electric scooters and public transport (trams and buses). We described the demographics and transport situation of the city in study, then we calculated different types of public transport accessibility indicators. We thus investigated, through an online mobility survey in the city of Iași, what are the preferences declared by respondents in terms of transport and what are the socio-economic characteristics of potential users of electric scooters, in combination or not with public transport, and if they would give up regular travel by personal car in the light of introducing a modern alternative that increases general accessibility.*

**Keywords**: Travel demand; urban accessibility; e-scooters; multimodal transport.

## 1. Introduction

"Accessibility, as an intrinsic attribute of the physical network, means the ease, less or greater, through which one can reach a point j from a point i or from all other characteristic points of the connected network" [1]. The accessibility is an expression of the mobility offer that a community can benefit from, being thus a consequence of the landscaping actions [2].

Travel surveys and mobility studies focused, during the time, mostly on the „classical" modes of travel, i.e. public modes, car, maybe walking or cycling, but very few of them considered the access and egress modes, which are proven to be an important factor of decision. The collection of the travel data is also difficult to obtain, because most people are not eager to spend their time answering to questions, especially without an incentive.

The study aimes to reveal the feasibility of a multimodal transport implementation, integrating public transport and electrical scooters, in order to ease everyday mobility of the travelers and replace a part of the private transport trips. The problem covered by the introducing of e-scooters is known in the literature as the first/last mile problem. The final objective is to develop a transport simulation model and use it to identify transport policies that can reduce the levels of congestion and emissions of pollutant gases, but this article will focus only on the

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accessibility of the population to the public transport and on the travel survey conducted in Iaşi, as entry points in determining the need of this solution.

The city of Iași was selected for analysis because it presents accessibility problems for the population living in the suburbs, as a result of the city expansion, while the public transport lines remained at the same configuration as few decades ago. Therefore, the number of cars has grown continuously, generating massive congestion and pollution.

## 2. A brief description of Iași in terms of demographical and traffic related characteristics

The city of Iași is in a continuous increase of the population, almost doubling its number of inhabitants in the last 10 years. If at the last census in 2011 it had 290,422 inhabitants, in 2019 it had already reached 507,100 inhabitants, due to economic and financial opportunities, which determine the migration of Moldavian citizens, but also the migration of young people from neighboring counties who come to study in Iași and settle there. The Iași metropolitan area is now the second largest in Romania, after Bucharest. The new city expanded in all directions, starting with the neighborhoods of Copou, Sărărie, Țicău, Tătărași, and continuing with Păcurari, Frumoasa-Poitiers, Socola, Bucium, Galata, Alexandru cel Bun, Dacia, etc. (figure 1). The urban trend is expanding, these localities being included in the metropolitan area, along with other localities: Păun, Bârnova, Horpaz, Miroslava, Valea Lupului and Breazu.

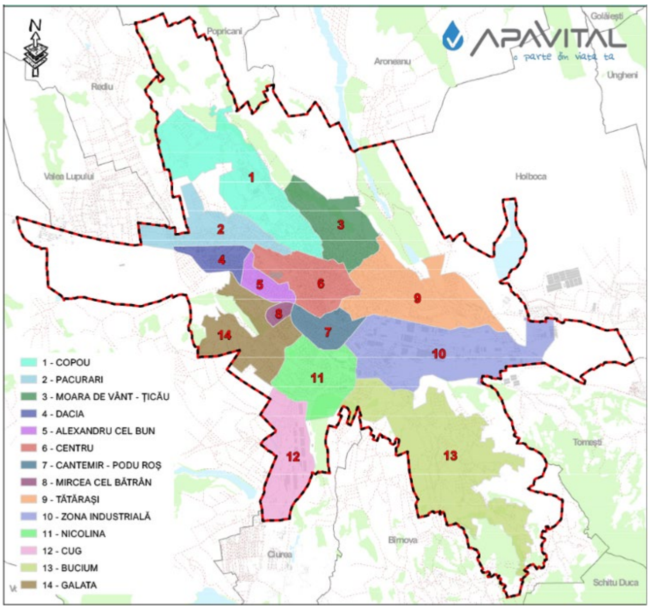


Fig. 1 The main neighborhoods in Iași (source: https://www.apavital.ro/harta-municipiului-iasi)

From the last national census, we found that the most numerous age category in Iași is the one between 30-34 years old, with 43253 inhabitants in 2021, followed by the one between 35-39 years old, with 30374 inhabitants. Also, the younger age groups are more numerous than the older ones, which means that the population is predominantly young and growing. According to the National Institute of Statistics, in 2020 there was an average number of employees of 115263 in Iași, and the average net monthly nominal salary of 3317 RON. In March 2022, their number was already 184637 people, increasing by 5324 people compared to the same month in 2021 and by 830 people more than the previous month.

The public transport network is a complex public or private system that must equally meet the mobility needs of the population of an urban system. Public transport has proven to be much more economical and energy efficient, and the space occupied is much smaller. The percentage of public transport use differs greatly from one area to another, for example we have 2% of the population in Atlanta or Los Angeles, 4-5% in Brisbane or Perth, 7% in Melbourne or Sidney, 14-16% in northern European cities, 26-31% in cities such as Barcelona, Vienna, or 35-45% in Eastern European cities (Bucharest, Kyiv, Budapest) [2].

The current street network of Iași, developed on the basis of the one from the Middle Ages, became too small during peak hours, due to the increasing number of cars, leading to traffic jams in the main intersections: Unirii Square, Mircea cel Bătrân, Railway Station, Podu Roș, Podu de piatră, etc. Starting with 2017, the Public Transport Company (CTP) Iași operates in the city 8 tram routes and 25 bus lines (table 1).

*Table 1*

**Public passenger transport in Iași (source: https://iasi.insse.ro/produse-si-servicii/publicatii-statistice/anuarul-statistic-al-judetului-iasi/)**

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| ***Length of the lines (km)*** | | | | | | |
| *Trams* | 83 | 83 | 83 | 79 | 79 | 79 |
| ***Number of vehicles*** | | | | | | |
| *Trams* | 150 | 151 | 124 | 126 | 126 | 126 |
| *Buses* | 278 | 207 | 161 | 169 | 169 | 166 |
| ***Passengers (thousands)*** | | | | | | |
| *Trams* | 60576 | 65107 | 75281 | 73721 | 35472 | 28025 |
| *Buses* | 89238 | 88667 | 89292 | 101373 | 46180 | 36061 |

The number of cars registered in circulation in the city of Iași has also continuously increased, from almost 80,000 in 2007 to over 200,000 in 2020 (figure 2). It must be taken into account, however, that the real number of cars circulating in Iași is much higher. This is due to several factors, including the fact that it is a university city, and many students from other areas come with personal cars, many young people who settle in Iași register their cars in the name of their parents to pay cheaper insurance, etc. As can be seen in the figure 2 below, the number of cars has increased from year to year, but the length of public roads has remained approximately the same, which means that the degree of congestion is also increasing.

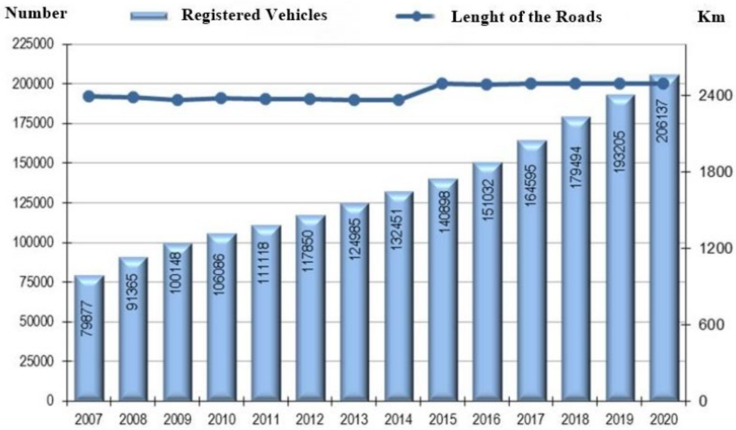


Fig. 2 The official number of cars registered in circulation in Iași and the length of public roads (source: https://iasi.insse.ro/produse-si-servicii/publicatii-statistice/anuarul-statistic-al-judetului-iasi/)

Transport is not considered an activity or purpose per se, so it is in a dynamic regime of adaptation to socio-economic functions [3], and with the hypertrophic extension of the city, it became much more difficult for public transportation to serve all the suburbs [4].

## 3. Data Collection

Surveys play a key role in assessing mobility, and the volume and quality of data collected are essential for correctly understanding travel behavior, assessing generated and attracted flows by points of interest, but also identifying appropriate solutions to meet mobility needs and assess their effects. The hypotheses aim at the evolution of the characteristic variables/parameters, the correlations between the movement behavior and the belonging to certain population groups or their response to certain stimuli [1]. Current modelling capacity improved considerably, and it became more and more important to represent the different multimodal stages of a trip, in order to develop better planning and transport policy. It was not until the early 1990s that transport surveys began to take into account, in addition to motorized journeys, both largely to work and non-motorized journeys, i.e. walking and cycling [5]. The majority of the studies focused on walking and bicycling as access and egress options, but I will focus on electrical scooters for the same purpose.

We realized an online transport survey, using the Google forms application, containing 16 questions and which was posted on various Facebook groups of the city of Iași, obtaining 492 answers, within 2 months (April-May 2022). The form can be visualised at the following link: https://docs.google.com/forms/d/e/1FAIpQLScL-TgG2Bx3mcip3bzU5b2IAkxUbE82NrypCiGPbjKQ-y22ng/viewform. The survey is aiming to extract the socio-demographic characteristics of the respondents, as well as the mobility tool holdings, which can represent factors of influencing the choice of mode. We will not make a detailed activity separation in our study, we will rather consider just two categories, trips for work and trips not related to work.

We found that 57.5% of the respondans posses a private car, but only 7.3% posses a private e-scooter, a low percentage, but as it was expected, considering the salary levels in Iași. Concerning the transport modes they use mostly for work trips, the majority of 43.7% answered they use public transport, 40% use a private car, and the rest use walking or other means (Fig. 3).

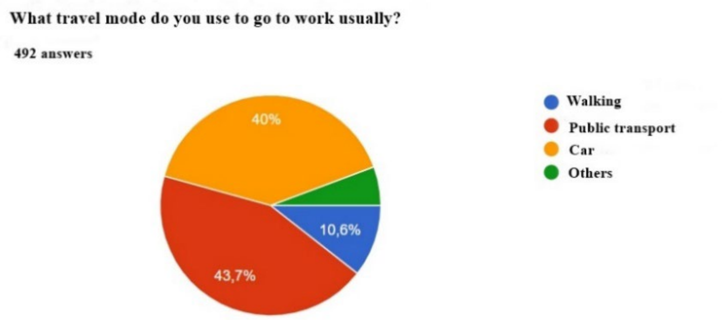


Fig. 3 Answers of the work trip modes from the survey

For the non-work trips, the results were a little different, 47.6% using a private car and only 32.1% using the public transport. The repartition by distance to the closest public transport stop is almost even in each category, from 0-200 m to more than 1000 m, similar to what Roșu (2013) determined in his study. Regarding the questions about electrical scooters, we find that 43.3% of the population have seen e-scooters available in their home area, but small percentages of people would use one for different activities. Only 13.4% would ride an e-scooter from home to work, 22% and 12.4% would use an e-scooter as access to public transport, respectively egress, and 32,9% would pay for an e-scooter for other activities, like to try it for fun. The last question from the survey concerned the reasons of which the people would not use this kind of modern micromobility mode. Not surprisingly, 51.4% of the answers accused the fare that is considered too expensive, at least to use it regularly.

## 4. Urban mobility indicators

Transport accessibility is considered an essential component in overall spatial accessibility assessment, that is the most important tool for transport planning. This concept aims to express how easy or difficult it is to travel to different locations by different transport means [6]. Accessibility can be measured by the distance between a destination and public transport stops or by the length of a journey from an origin to a destination via public transportation [7]. A particular destination, which may represent an economic activity or point of interest, is considered accessible if it is connected via a transport network to other social locations or other economic activities. Accessibility is correlated with the notion of connectivity, being able to evaluate an accessibility indicator through network connectivity [8]. When we talk about the performance of public transport networks, often assimilated with a yield, we refer mainly to the quality/price ratio that integrates the idea of efficiency rather than efficacity [2]. Baraklianos et al (2019) classified the accesibilities as following (table 2) [9]:

*Table 2*

**Equations of accessibility estimation indicators [9]**

| Indicator | Estimation function | Parameters |
|---|---|---|
| Integral accessibility | $A_j = \sum_{i}^{n} \frac{t_{ij}}{n}$ | $t_{ij}$ = travel time from i to j<br>i = origin station<br>j = destionation station<br>n = number of OD pairs |
| Isochronic accessibility | $A_j = \sum_{i}^{n} O_i * \gamma$ | $O_i$ = population of station i catchment area<br>i = origin station<br>j = destionation station<br>n = number of OD pair<br>$\gamma$ = indicator equal to 1 when $t_{ij}$ is smaller than the defined travel time limit, and 0 otherwise |
| Passive potential accessibility | $A_j = \sum_{i}^{n} \frac{O_i}{t_{ij}}$ | $O_i$ = population of station i catchment area<br>i = origin station<br>j = destionation station<br>n = number of OD pair<br>$t_{ij}$ = travel time from i to j |

Accessibility in the territory of the citizens for various activities, such as work, trade, school, recreation, etc., presents the following performance indicators of public transport:

- spatial access, by covering the territory with public transport lines;

- temporary access, through the frequency adapted to the demand (minimum of the regular service and maximum to the peaks of the demand);
- intermodality, by ensuring stability and continuity of movement [1].

Nykl et al. (2015) developed a method to analyse the accessibility in multimodal urban transport systems based on a full-detailed representation of the transport system, a method taking into consideration the complete maps of the roads, exact timetables for the public transport, footpath and cycleway networks [6]. Although his method does not rely on point-to-point route calculation, but on a modified Dijsktra's algorithm to determine single-point multiple-destination route calculation, it is extremely laborious and time-consuming to implement. Saghapour et al. (2016) worked on a study on public transport accessibility that considered public transport service frequency, but also taking into consideration the population density as an important distributional indicator [7]. Another study based on an indexing system was the one conducted by Parvathy et al. (2013) for Thiruvananthapuram urban area. They determined the public transport accessibility levels of their study area, which consists of a detailed measure of the accessibility of a point of interest to the public transport network, taking into account service availability and walk access time. A new notion involved is the Equivalent Doorstep Frequency (EDF) [10].

Roșu (2013) used various methods of analysis specific to quantitative elements to determine indicators of mobility and accessibility of the population to public transport in Iași, such as [2]:

- population density, using the Kernel method; this is a method often used in statistics to estimate the probability density function of a random variable. Density estimation involves processing a finite set of data and making inferences about the general population. It turned out that in Iași, the population is concentrated in several areas, more precisely in the neighborhoods of Dacia, Alexandru cel Bun, Pod Roș or Galata, built in the postwar period in the S-W of the city, as a result of communist ambitions for urbanization, but also in the Tătărași block of flats in the NE;

- density of public transport stations, using Thiessen polygons. This is a graphical method by which the areas of influence of each public transport station are visualized, drawing lines perpendicular to the halves between the 2 stations, lines that intersect later. In figure 4 we can see these areas of influence, to which were added the population density values:

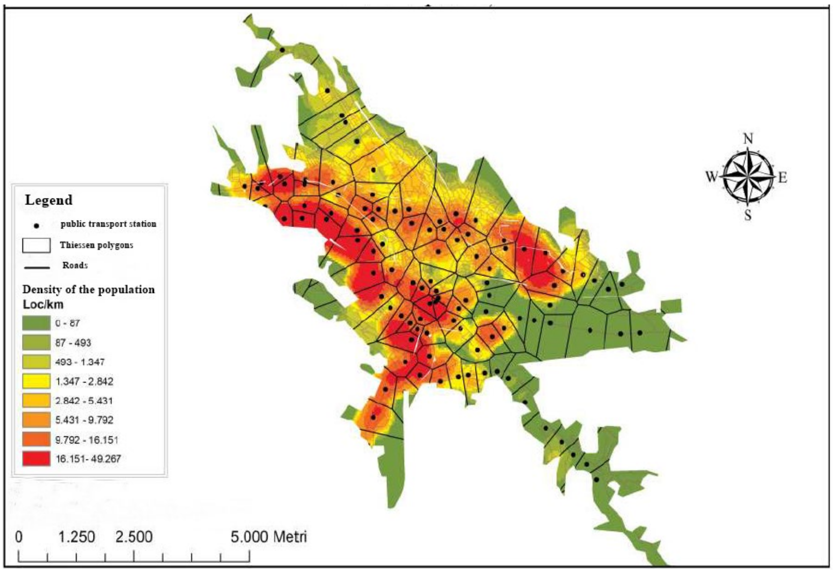


Fig. 4 Population density in Thiessen polygons on public transport stations [2]

For Iași, we can observe that the highest density of public transport stations is found in the intersection nodes of the main boulevards, and not in the areas with the highest population density;

- the distance to the nearest public transport station, which takes into account 2 variables: the location of the population and the location of the public transport stations. The highest values of the use of public transport stations are in the areas with high population density, in the neighborhoods Alexandru cel Bun, Dacia, Tătărași, Păcurari, in the south of the city, and the least served areas by public transport are Țicău, Galata houses, Oancea, Bucium and Breazu residential neighborhoods, located on the outskirts. As Euclidean distances, it was determined that the inhabitants of Țicău, Oancea or Galata houses have to travel in a straight line distances of up to 1000 m to the nearest public transport station, accessibility problems also exist in some central areas, due to winding alleys and steep slopes. The conclusion is that most of the population in Iași is well served by public transport, but there are major shortcomings in serving the population in peripheral areas [2].

### 4.1 Examination of the accessibility of the inhabitants to the means of transport by means of isochrons (QGIS)

The peculiarities of the urban transport network make the most accessible points of the city not the closest, but those to which travel takes less time. Thus, the travel time, the most important indicator of public transport, can be calculated using isochrons, which represent the geometric location of points equally distant, in time, from the point of interest. The realization of isochrons involves, first, determining the total duration of the trip, more precisely the time needed to get from home to the place of interest, then determining the values of each component: travel time by public transport, waiting time in station and walking time to the station. Finally, depending on the shape of the street network and the organization of traffic, the shapes of the isochrons are represented graphically. The higher the density of the transmission network, the higher the area covered by the respective isochron [3]. The calculation of isochrons will be based on the following mathematical formula:

$$d_{total} = \frac{d_{i-j}}{v_c} + d_{walking} + d_{waiting} \qquad (1)$$

where:
- $d_{total}$ = the size of the isochrone [min];
- $d_{i-j}$ = travel time from station i to station j by public transport [min];
- $v_c$ = commercial or section speed [km/h];
- $d_{walking}$ = walking time from the starting point to the closest transport station [min]
- the speed of 4,5 km / h is considered;
- $d_{waiting}$ = average waiting time before the arrival of public transport [min].

We will calculate the accessibility of the inhabitants to the means of public transport with the isochrones method with the help of the QGIS software package, without taking into consideration the use of e-scooters. The calculation of an isochron will take into account a destination, considered a point of attractiveness of the city, and a main transport line that reaches that point. The aspect of interest in this case will be the accessibility of the inhabitants from the proximity of the terminal stations of the transport lines, so of the inhabitants from the peripheries, to the usual destinations from Iași, consisting in a list of points of interest, for certain time intervals. The QGIS application is based on the OpenStreetMap (OSM) geographic database, which is available in open source format (free of charge), to which point layers can be added, between which the distance, the shortest route, isochrons, etc. can be calculated.

Example: determination of the isochrons on the route of tram 1 (figure 5), with the destination point Gara.

1. Tram line 1: Tătărași Nord – Gară
   Total time = 30 min
   Waiting time in the station = 12 min
   Commercial tram speed = $v_c$ = 15 km/h
   Time on public transport = Distance / $v_c$
   Average walking speed = 4,5 km/h = 1,25 m/s

*Table 3*

**Isochrones calculations for tram line 1**

| Tătărași Nord - Gară | | | | | |
|---|---|---|---|---|---|
| From station x to station y | Total time [min] | Time on public transport [min] | Waiting time in the station [min] | Walking time [min] | Walking distance [m] |
| Tătărași Nord - Gară | 30 | 15 | 12 | 3 | 225 |
| Ateneu - Gară | 30 | 13,5 | 12 | 4,5 | 337,5 |
| Pădurii - Gară | 30 | 11 | 12 | 7 | 525 |
| Tg. Cucu - Gară | 30 | 8,8 | 12 | 9,2 | 690 |
| Filarmonică - Gară | 30 | 7,2 | 12 | 10,8 | 810 |
| Piața Unirii - Gară | 30 | 5,6 | 12 | 12,4 | 930 |
| Voința - Gară | 30 | 2,8 | 12 | 15,2 | 1140 |
| Str. Bacinschi - Gară | 30 | 1,4 | 12 | 16,6 | 1245 |
| Gară | 30 | 0 | 0 | 30 | 2250 |

Fig. 5 Tram 1 route in Iași

The following isochron sequence is obtained, made in the QGIS program, with the ORS Tools plugin (figure 6). It can be noticed that for the inhabitants near Tătărași Nord and Ateneu stations, the destination station is not accessible for a total duration of 30 min.

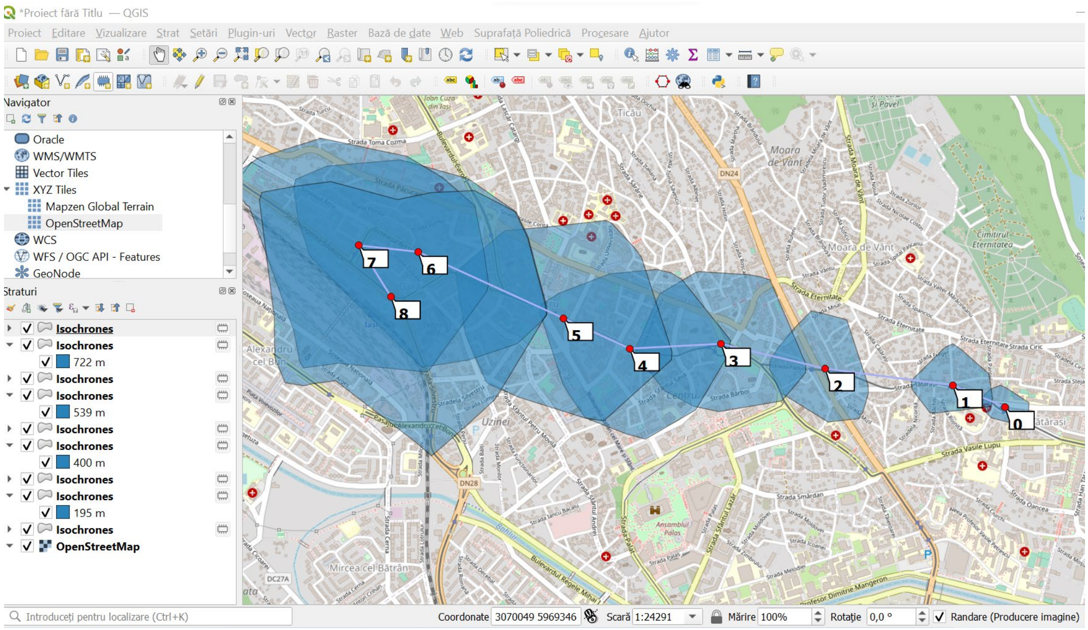


Fig. 6 The isochrones calculated for the tram line 1 in QGIS

We calculated the isochrones for each line of the 8 trams and 25 buses to 8 identified points of interest (of attraction) in Iași (Palas Mall, Copou park, Carrefour hypermarket, Central Train station, etc.), totalling a number of 264 isochrone iterations. Where the destination point was not on the line or close, we considered a change of line. For a total travel time of 30 minutes, it resulted that the destination station was accesible for the inhabitants near the end of line stations only in 168 cases. The total duration of 30 minutes was considered given the size of the city, a medium one, for large cities we would propose at least one hour. The conclusion is that around 36% of the population from the periphery doesn't live close to a public transport station and need to walk a considerable amount of time. We consider them eligible for renting an electrical scooter, and if we consider an average speed of 20 km/h for it, 4-5 times faster than walking, it means that for almost all the people from the periphery, the points of interest will become accessible, while the time of travel will be smaller than with the car and more eco-friendly.

### 4.2 Examining the accessibility of the inhabitants to the mobility services

Another useful indicator for determining the accessibility to mobility services concerns the percentage of the population with easy access to public transport (tram, bus) and is calculated with the following formula:

$$\mathrm{Acf} = \frac{\sum_i \mathrm{PAf}_i * \mathrm{Q}_i}{\mathrm{pop}}, \qquad (2)$$

*where:*

Acf = ease of access index [% of population]
$PAf_i$ = the number of people living in area i
$Q_i$ = degree of appreciation of the ease of accessibility to mobility services. This degree is predefined and takes the following values :

- $Q_i$ = 1, if the access is very easy [0-200m];
- $Q_i$ = 0,5, if access is easy [200-400m];
- $Q_i$ = 0, if access is not easy [> 400m];

Following the transport survey conducted in the city of Iași, we found that 9.6% of the population live at a distance of 0-200m from the nearest public transport station, and 16.5% live at a distance of 200-400m. The other categories are not considered, because $Q_i$ = 0. Thus, we will have:

$$Acf = \frac{xx\%*1+xx\%*0.5}{507100} = \frac{48681.6*1+83671.5*0.5}{507100} = 17{,}8\%$$

We conclude that 17.8% of the population has very easy access to public transport, a percentage not very high, given the expansion of the city to the outskirts, without the expansion of public transport lines. These people are unlikely to use electric scooters for anything other than walking and fun, but the rest of the population remains eligible for our multimodal transportation study.

## 5. The expansion of electrical scooters

The relatively new concept of Mobility-as-a-Service, as well as the public transport and the shared mobility, they all aim to mitigate the impact of travel demand, and promises a more efficient and user-centred mobility paradigm [11]. Promoting energy efficient and green ways of daily commuting is one of the main concerns when talking about sustainability and the future mobility. Therefore, the worldwide expansion of on-demand rental electrical scooters produced new opportunities for urban mobility, facing in the beginnings also with several problems of reliability and conflict [12].

The main purpose of the micromobility is to cover short distance trips, here being included the first/last mile problem. This problem concerns the access and egress stages, which along with waiting and transfer times are considered the weakest parts of a multimodal public transport chain, while their contribution to the total travel disutility is substantial [13]. In the micromobility category we can include any small and light-weight vehicle, that do not reach speeds over 45 km/h, bicycle or scooter, electric or not, privately owned or not [14]. The shared ones goes into the Mobility-as-a-Service category. The electric car is a good start in reducing carbon emissions, but having still single occupancy vehicles weighing many times the weight of the passenger, having to be recharged often and still not solving the issue of congestion is not sustainable enough [12]. Sanders et al. (2020) found that the e-scooter is a convenient way of travel especially in the heat, to replace walking, and that it gets people to their destination 22% faster than the bicycle. Figure 7 describes best the answers concerning the benefits of e-scooter riding, from their survey in Tempe, Arizona [15].

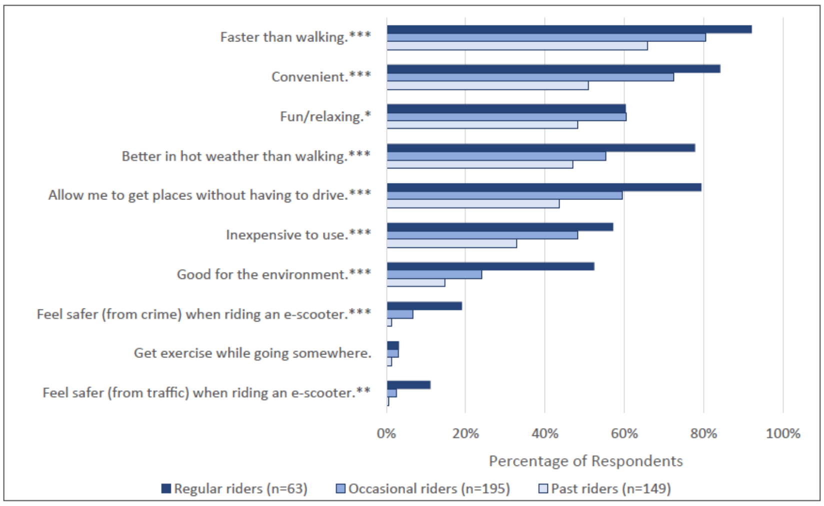


Fig. 7 Perceived Benefits of Riding E-scooters, by Frequency of E-scooter Usage. Significance between rider types indicated by the following: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$. [15]

If the e-scooters and the public transport would be integrated, as a multimodal transport, the utility would grow exponentially [16]. The purpose is to increase the competitivity of public transport against the car, in terms of costs and travel time, but also to contribute to the limitation of congestion and pollution. The share of e-scooter users remains quite low (4,9 – 7.1%) in most of the cities analyzed, compared to the shares of other travel modes [17].

Starting with April 8, 2022, electric scooters provided by Lime are available for rent in Iași. According to the Lime company, the scooters will initially be available in the Palas, Copou, Pod Roș, Dacia, Tudor Vladimirescu neighborhoods. In order to use this service, the user must download the mobile application "Lime" (figure 8), where you can see the location of available scooters, thanks to GPS technology, choose the nearest scooter and unlock it with your phone, scanning a QR code from it. At the end of the trip, the electric scooter can be left anywhere, within the defined perimeter, requiring a photo with it in a suitable place to end the trip. The usage costs are 0.68 RON/minute, and the unlock costs 2 RON.

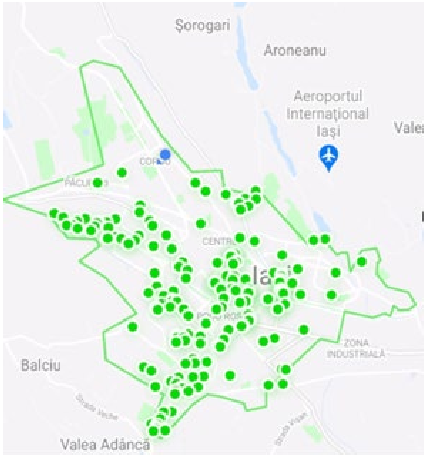

Fig. 8 Lime application – Iași city – available scooters

For Romania, the costs are not considered the most affordable for long distances, for the moment, considering a 30-minute trip, for example, the cost would be 22.4 RON, and for one hour, 42.8 RON.

Despite all the benefits of this new travel mode, the introduction of e-scooters started considerable public debate, because it started to have an impact on the other users of the public space, like pedestrians who don't feel safe anymore on the sidewalks, because some users drive irresponsibly. James et al. (2019) showed that 16% of the observed e-scooters were not parked properly, while 6% of them were blocking pedestrian access. This lead to public complains or even acts of vandalism [18].

## 6. Conclusion and recommendations

Calculating the accessibility of the inhabitans of Iași to the means of transport and the main points of interest, via different methods and techniques, we conclude that the accesibility of the population from the outskirts is not at the highest levels. From this reason, the use of personal car is quite high, largely contributing to congestion and pollution. Therefore, we find opportune and desirable the implementation of transport policies that include the electrical scooters, which will contribute to the increase of traveler's accessibility and decreasing the congestion. The share of e-scooter users in Iași is still quite low, the main cause being the high price of the fare, according to the answers received on our survey. Anyway, the percentage of the people that would use an e-scooter for leisure trips, usually for fun, is the highest from all studied purposes, 32,9%. We recommend to the public authorities to implement different solutions that will promote the general use of public transport in combination with electrical scooters: a public-private collaboration with the e-scooter providers, offering an integrated pass, discounts and different benefits for this integrated multimodal mode, as well as facilitating parking spots for the e-scooters near the public transport stations, creating dedicated lanes for e-scooters and/or using the same ones for bycicles, where existing.

The follow-up of this article consist in the construction of a multimodal transport model composed of public transport and electrical scooters, defining utility functions for each transport mean and combination of them, the calculation of travel utility in diferent conditions, using a multinomial logit model, based on the discrete choice modelling theory. Then we define some fare price transport policies to see how the travel utility modifies and we calculate the Willingness-to-Pay (WTP), an indicator for various policy or product options about how much the respondants are willing to pay for one service or product.

As a recommendation for future research, it would be interesting to study the correlation between the level of education and the willing to use an e-scooter, combined or not with the public transport, because I think that the willing to help to reduction of pollution by not using so much the own vehicle and that for all the comunity is better to use the common ways of transport comes also from a good education. Also, it would be interesting to investigate the difference of travel utility between the ones that go to work every day, the ones that work only from home and the ones who work in hybrid mode.

In my opinion, the evolution of the adoption of the electrical scooters, considered also in the multimodal context, should be studied periodicaly, because it has many chances to evolve. The fact that these micro-vehicles are incorporated with a GPS can lead to specific GPS travel surveys, with the help of the e-scooter providers.

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