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Citizens' wishes and issues for urban mobility services of Rio de Janeiro

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Abstract

Smart cities have been the target for the development of several technologies, notably in the field of urban mobility. However, issues related to citizens' commuting need to be addressed beyond technology but focusing on the population and the context in which they live. This paper aims to discuss citizens' wishes and issues for the city of Rio de Janeiro to think about how we can achieve the so-desired smart city. From design workshop sessions with citizens, we intended to understand, through a dynamic in thinking about wishes for a short- and long-term future, which solutions we can give for the future of urban mobility considering their particularities. Several points were raised regarding governance, infrastructure, safety and security, and transportation modes, as well as technologies that could benefit citizens. The results may contribute to developing innovative service design proposals for urban mobility suitable for city contexts similar to the city studied.

Keywords: smart city, urban mobility, co-design, future thinking

Introduction

Smart cities are conceptualized primarily as cities supported by information and communication technologies (EC, 2020). However, they are also considered sustainable, inclusive, and citizen-centric cities (OECD, 2020). Thus, the focus is on developing innovative technologies and services that enable the citizen's well-being and quality of life, in line with environmental protection, to contribute to the city's economic growth. In this context, several themes must be addressed in the set of what is understood as a "smart" city (Kirimtat et al., 2020), such as smart economy, smart governance, smart environment (sustainable resource management), smart

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mobility (smart transportation), smart people (citizen), smart life (smart building, quality of life).

In urban mobility, many innovative technologies and services have already been developed to achieve more seamless mobility and a more comfortable citizen experience. These technologies and services include connected and automated vehicles, sensors and traffic monitoring systems, vehicle sharing, and ride-sharing, among others. However, developing such artifacts does not always make them a smart solution once not all of them consider the particularities of a population in a specific context.

Measures to improve urban mobility should take into account people's needs and perspectives. The solutions for a smart mobility shouldn't only consider technology requirements but also the different impacts upon different groups of people (Vallet et al., 2020), through *co-design* process. This idea stands for "the creativity of designers and people not trained in design working together in the design development process" (Sanders & Stappers, 2008, p. 6). In other words, the users, who normally just use what it's available, should be part of the process of creating the solution that they need, by sharing experience and generating ideas.

Also, in this context of urban mobility, there are concepts like the 15-minute city, that is defined by the possibility of executing daily activities within a distance of a 15-minute route from one's home, done by walking, riding bike or scooter or even taking public transports (Moreno, 2020). This demonstrates the importance of micro mobility (including mostly bicycles and scooters) since it shows how economically affordable, safe, healthy and sustainable this type of transportation is (NACTO, 2018). Here, shared mobility services also play a main role in ensuring the access to micro mobility, small vehicles and even ridesharing. The overcome of the use of shared mobility is, inevitably, the reduction of driving and personal vehicle ownership and vehicle kilometers traveled (Shaheen et al., 2016).

Despite the benefits of a 15-minute city, it is still critical to understand who the citizens are, what context they live in, and how the city's culture, climate, and topography influence the built spaces. A co-design process needs to consider these particularities, while smart cities are not only valuing urban areas but also natural, social, cultural, and economic circumstances (NACTO, 2018).

Thereby, the following paper regards Brazil's scenario, focusing on the city of Rio de Janeiro. Historically, the highway network in Brazil was developed because of government policies based on expanding roads that could follow urbanization. However, it was only around 1950 that President Juscelino Kubitschek's government started a new policy to incentivize the automobile industry in Brazil, boosting the

economy. Notably, the privilege of private vehicles over public transportation in Brazil is a latter movement that aggravated the continuous deterioration of public services, especially in Rio de Janeiro (Borba et al, 2022).

Rio de Janeiro is the third biggest state in population within the country, with 17.4 million citizens, and 39% of its population is concentrated in the capital of Rio de Janeiro (Borba et al., 2022), a coastal city surrounded by hills (Figure 1). In 2020, with 4.5 million automobiles, Rio de Janeiro state had the third biggest fleet of the country, and the city of Rio, by itself, gathered 44.6% of the state's automobiles.

Figure 1. Views from Rio de Janeiro landscape. Photo by Riotur

Besides automobiles, the citizens of Rio de Janeiro rely on five biggest means of public transportation as: bus, train, ferry boat, subway and BRT (bus rapid transit) (Borba et al., 2022), and a private bike sharing service called Bike Rio (Andrade et al, 2021). Among all of these transportations, ferry boats and subways are the ones that satisfy its users the most, according to Borba et al. (2022).

These numbers and information exemplify Rio de Janeiro as a city of many possibilities towards mobility; yet, there are still some transformations to be accomplished to increase the well-being of Rio de Janeiro's citizens and become a

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smart city. For this purpose, it is still necessary to understand the citizens' perspective, the main difficulties they face nowadays, and their wishes for the future in order to have input to design better mobility services.

Therefore, the aim of this article is to identify how we should deal with the future of mobility and to discuss mobility and transport services, current as well as future ones, based on the word of citizens.

Method

In order to understand Rio de Janeiro citizens' perspectives on their needs, complaints, and wishes, co-design workshop sessions were conducted, focusing on short- and long-term future scenarios. Through social media and direct email, citizens were invited to participate in remote sessions, between February and October 2021, via video meeting Zoom platform (Zoom.us), due to the COVID-19 pandemic. Six workshop sessions of approximately two hours were conducted, with 4-6 participants per session, totaling 32 participants - most of them travelers from the south zone, but there were also travelers from the north and west zones of the city. After signing the consent form, the participants received the link to the session, whose dynamics unfolded with creating boards in the Miro application (Miro.com) in a virtual room in Zoom.

In each workshop session, participants were initially introduced to the study's context with numbers, data, and trends. They were then directed to individual boards and assigned the task of envisioning the ideal future of their city for 2030 and 2050, focusing on urban mobility (Figure 2). Using text, images (already available on a large board adjacent to the individual boards), or drawings, participants were free to express themselves according to their preferences. They were also encouraged to answer questions written on their boards as a means to shape their visions of the future (Table 1). After 20-30 minutes of individual work, all participants were invited to share their wishes and explain the motivations behind their ideas, fostering group discussion.

The data collected in the workshop sessions consisted of the boards created by each participant and their own words, registered later in interpretation sessions with the researchers. Subsequently, the gathered results were analyzed through affinity diagram sessions (Marsh, 2018). In these sessions, each wish and concern expressed by the participants were grouped in a top-down manner according to established criteria for urban mobility analysis in a previous phase of the research, considering separate futures of 2030 and 2050. These criteria included assessment

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of traffic conditions, punctuality and availability of public transportation, safety, integration of payment systems, diversity of transportation modes, interaction with digital technology, data sharing, costs and fares, environmental awareness, travel time, accessibility, micro mobility, shared mobility services, travel privacy, comfort, and vehicle ownership (Quaresma et al., 2022). Additionally, within each criterion, the expressed wishes were further regrouped using a bottom-up approach, allowing for the identification of emergent themes based on recurring and similar wishes.

Questions for future thinking on urban mobility

- How would you envision mobility in your city given the population growth?
- How do you envision yourself moving around the city in the best possible way? (consider what currently pleases you and what doesn't)
- What modes of transportation would you like to use in the future?
- What do you think would be ideal for public transportation in your city? And for private transportation?
- How much time do you think your commute should take in your city? (for work, shopping, etc.)
- What technologies and services do you think would be ideal for your everyday life in your city in the future? What new solutions could exist?
- How do you think the ideal cost of transportation services should be?
- How would you like a sustainable city to be?

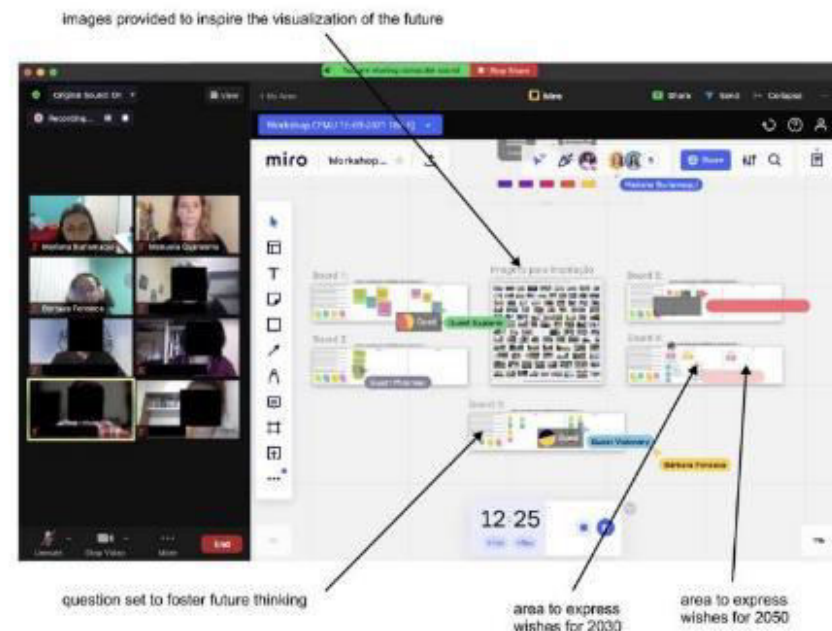Table 1. Question set used to foster future thinking during the workshop.

Figure 2. Workshop session setup in Zoom platform. Image by authors.

Results

From the analysis of all boards and the participants' narratives, for most of the wishes they listed, issues related to the current city's mobility conditions were pointed out. Furthermore, we observed that for a possible near future (2030), most wishes were focused on solutions for current problems, while for a distant future (2050), the ideas were more disruptive.

In general, Rio de Janeiro's citizens report a lack of safety and security in mobility. Due to high violence rates and a significant number of traffic accidents, the participants expressed being in a constant state of vigilance when traveling around the city, whether by car, bicycle, public transport, or walking. Many of these mobility accidents happen due to the deficient urban infrastructure in Rio de Janeiro. Nowadays, bumpy roads, narrow sidewalks, dangerous bicycle paths, and poor planning for suburbs are examples of this deficiency. These issues and the considerable distances inside Rio de Janeiro entail other problems such as huge traffic congestion. Because of that, the participants mentioned how stressful it is to take a bus or drive their cars since they do not know how long it will take to arrive where they need to.

The use of bicycles was also another specific issue reported by the participants. Although there is a bike-sharing service and bike paths and shared lanes in Rio, the conditions of use of this service still need to be more satisfying since cyclists are sometimes forced to cycle very close to bigger vehicles on high-speed avenues. Some participants reported being afraid to ride a bike, and others also pointed out the fear of being robbed when using bicycles.

The participants also show a feeling of vulnerability about using ridesharing services for not knowing who will share the ride with them and who the driver is. This was a concern shown mostly by women. Currently, services such as Uber, Bla Bla Car, and traditional yellow taxis operate in the city - all managed through mobile applications.

Many other concerns related to urban mobility were reported by the participants, most of them related to the city's governance and public transportation and the geographical characteristics of the city. There is still a backwardness and precariousness of vehicles and public services for the citizens, especially regarding the availability and integration of transportation modes, fares, and payment systems. These issues lead to more intense use of private vehicles and, consequently, to an increase in traffic jams and the time spent traveling in all kinds of transportation. The city's high temperatures also do not make it possible to commute more intensively by bicycle or walking, even though there are many green areas throughout the city.

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Interestingly, the participants also discussed the need for more use of rivers, bays, lagoons, and waterfronts for people's transportation. Besides being an excellent option to escape from traffic jams, it would also be the best way to enjoy Rio's beautiful landscapes. Some participants criticized the little exploration in transportation that allows contemplating the view of the city, which could be beneficial considering its tourist characteristic.

Wishes for the future of mobility in Rio de Janeiro for 2030

Efficient micro communities. The first wish of participants for 2030 were for more organized city, favoring landscaping neighborhoods, better sidewalks, and planned routes according to local particularities. One of their wishes, to cooperate with this organization, is about the city division in cells, reducing extensive urban traveling and amplifying the access to essential services and places, similar to the 15-minute city concept. The neighborhoods, then, become more integrated and absorb employers into close by jobs without any need for people to cross the city for work. Many jobs could become remote, and citizens who still need to attend face-to-face work can live near their workplaces.

Centerless city. Furthermore, the participants pointed out wishes for the reduction of urban flows that converge on Rio de Janeiro's center with the relocation of workplaces in order to provide more accessible spaces for new plazas and natural parks near rivers, lagoons, and bays. They also wish for more cycle paths connecting this central area to others inside the city, allowing people to circulate by bike, scooters, and skateboards. Participants wished for areas for micro mobility only, so people could feel safer using these types of transports.

Integrated transport systems. Rio de Janeiro's citizens also indicated a wish for mobility focused on public transportation and shared mobility. Within this hopeful scenario, there is an extensive diversity of transport available for every person to use, with more subway stops, new bus routes, and more investment in transport by water. Hence, there are more unified transport stations, where citizens can take any means of transportation, and apps with transport information.

Shared and sustainable mobility. There is also a wish for more stations of shared mobility spread across the city and granting more options for Rio de Janeiro's citizens, who can pick bicycles, scooters, and cars at every corner. Consequently, this shared mobility can reduce private vehicles on the streets. Similarly, another wish that diminishes greenhouse gas emissions is the promotion of electric vehicles charged by battery stations or solar power lanes. Rio de Janeiro of 2030 is, then, a city dreamt of being more sustainable and accessible.

Wishes for the future of mobility in Rio de Janeiro for 2050

Flexible workplace and commute. 2050, however, is a year for more transformations from the point of view of Rio de Janeiro's citizens. It is visualized as the peak of technology advances focused on the human being, enabling changes such as more remote work and holographic presence in meeting rooms. For this reason, the lifestyle is less fixed since people can live far from the cities and still manage to work with easy access to the internet.

Empowered suburban communities. There is also a wish for smart neighborhoods supplied by local productions, enhancing the quality of local life, mostly in suburbs that had been neglected before. Hence, these neighborhoods are divided into three microregions: nature and entertainment area, work and business area, and living area.

Timely and efficient mobility. A wish for punctual delivery services by drones and other autonomous vehicles that decrease overcrowding was also indicated to assist this new city. Thus, efficient mobility is valuable for employees for their commuting, where there are only four weekdays for working.

Enhanced and green micro mobility. New sustainable solutions help extinct fuel use, concretizing the wish for no greenhouse gas emissions. To that end, micro mobility is the base of mobility, at least in some parts of Rio de Janeiro. Most of them are requested to be electric, so the users can use them without making any hard effort, taking into account the high temperatures of Rio de Janeiro. Participants also wished for micro vehicles without wheels, such as magnetic scooters.

Connected mobility. There is a wish for urban areas for micro mobility and pedestrians only, separating the roads for bigger transports from paths for walking and micro personal transport. Therefore, the number of accidents can decline because of the high connection between every vehicle in the city, autonomous ones above all, and smartphones. This is a system made for localization sharing that avoids collisions between vehicles and between vehicles and people. For that, full Wi-Fi coverage is also wished by Rio de Janeiro's citizens, assisting this connection and sharing real-time information about public transport to citizens.

Seamless mobility. Regarding public transport in 2050, Rio de Janeiro's citizens wish for a more integrated system based on different means of transportation. Low-floor buses, subways, trains, trams (known as VLT in Rio de Janeiro), and shared cars are all electric and autonomous, increasing the urban flow speed and reducing traffic congestion. This is a scenario that facilitates the rapid transition from one transport to another, and citizens' wish for transit planning is accomplished. All of that

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is possible because smartphone apps allow citizens to pay for their transport tickets beforehand and have all the needed information in their hands.

Diverse futuristic transportation. Since speed is something important for the future, as the citizens mentioned, various transportation modes were elected for each specific condition and context of the city. Autonomous vehicles are one of the best options in 2050 for long-distance trips; once inside these vehicles, users can spend their time with other activities, such as watching movies or participating in work meetings, provided by the vehicle system. Other public vehicles, such as flying robot taxis (like VTOL - vertical take-off and landing aircraft) to transport people from the top of buildings and hills, are also wished for Rio de Janeiro as a result of its topography. Trams and hyperloops are wished for quick trips, connecting every part of the city. Lastly, new water transports such as jetski taxis and electric ferry boats can be very useful, considering a coastal city full of lagoons and bays.

In such a way, Rio de Janeiro becomes a city involved with citizens' safety and well-being, providing ways for enjoying outdoor activities and circulating through the city without any risks.

Discussion and Final Considerations

Following the proposal of the study, the activities presented in this paper helped in making advances and, above all, understanding the desirable future of mobility. The Design Workshop for Future Scenarios was planned to visualize the wishes and needs of citizens. Its objectives were achieved through every part of the workshop, from participants' responses expressing their wishes.

Firstly, this process enlightened us about current urban mobility concerns. The most mentioned issues by Rio de Janeiro's citizens, who participated in the workshops, were the: lack of mobility safety and security, primarily because of accidents and robbery cases; the lack of urban infrastructure and the insufficient maintenance of the existing one; and the huge distances traveled within the same city to get a daily activity done. This last one also leads to great traffic jams, and, consequently, no punctuality from public transports nor ridesharing services.

Secondly, to have a future with fewer issues, citizens from Rio de Janeiro revealed their wishes for a city more organized and with seamless mobility. For 2030, participants wished for better access to any point inside Rio de Janeiro, which is possible following the wish for reallocation of workplaces, and more remote work. Besides, people from Rio de Janeiro also wished for more unified transport stations

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where they could take any means of transportation they would like. Users can also transit between transports without waiting a long time for their arrival since, in this desirable scenario, there are urban mobility apps for smartphones that indicate every information about each transport.

The new range of integrated transport possibilities, including subway, buses, shared mobility, and ferry boats, is comfortable to every person, even the ones with disabilities, and brings a better mobility journey inside Rio de Janeiro. Therefore, private cars are less frequent on the streets, and the idea of sharing mobility is diffused.

For the year 2050, citizens from Rio de Janeiro wish for smart neighborhoods inside microregions, all connected and divided by: nature and entertainment areas; work and business areas; and living areas. Therefore, citizens wish for mobility based on a rapid integration between these areas, which demands micro vehicles that do not occupy much space.

A long-distance scenario is a place that is wished to have shared autonomous vehicles too, that do not need parking lots since they are constantly circulating on demand and can carry citizens that are going to similar places. This new way of mobility diminishes the number of vehicles on the streets, which helps extinguish traffic jams, aside from the express streets and avenues where vehicles can flow more quickly. Other transports wished for 2050, such as urban air transports and hyperloops, also assist in the fluid mobility of Rio de Janeiro.

For Rio de Janeiro's citizens, fossil fuels are also extinct from the future of mobility, concretizing the wish for no greenhouse gas emissions. There is also a wish for mobility based on electric vehicles that contributes to this scenario, most of those being micro mobility because of Rio de Janeiro's high temperatures. Hence, the mobility of 2050 for the city of Rio de Janeiro is hoped to be based on a merger between sustainability, accessibility, and technology.

Considering all this information reached through workshop sessions with people from Rio de Janeiro, specific points should be taken into account while planning the urban mobility of smart cities. The first one is the implementation of electric and surface vehicles, regarding, above all, the high temperatures and, then, the users' comfort. Thus, people can enjoy the open air and beautiful landscapes, such as the ones from the "Wonderful City" (as Rio de Janeiro is known). The second solution that should be fulfilled for cities like Rio is the uptake of air vehicles and cable cars due to its topography. People living on high hills need to run up and down daily. These means of transportation could help people go down and up without making such a hard effort, increasing their quality of life.

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Another important solution is the use of trams and micro mobility in overcrowded spaces. Accordingly, citizens' well-being boosts with people enjoying the landscape while traveling through the city in comfortable transport. Subways are the best solution for more extensive urban distances, but the city topography must be studied beforehand. On the other hand, there should be more investment in water vehicles for people's transportation. This can be easily done by profiting from the aquatic potential of cities with lagoons, channels, and bays. Following all this great diversity that is possible in these types of cities due to the geographic characteristics, it is also essential to consider ways of integrating all of these means of transportation and then achieve a full smart mobility system.

In terms of services for the future of mobility, it is important to consider that technology can be a highly efficient means of connecting people, both in terms of work and leisure connections within micro communities or neighborhoods, as well as connecting people with various mobility services in a smart and integrated manner. Technology-enabled services that promote the safety and security of citizens can also enhance the concept of a smart city, aiming to ensure a better quality of life for its users. Thus, the implementation of technology is not limited to the effectiveness and efficiency in the use of mobility products and services, but rather serves the purpose of meeting the needs of a population.

Although this study tried to manage as many different profiles of citizens as possible, it only approached the perspectives and wishes of a particular group of Rio de Janeiro's citizens. However, in terms of qualitative data, the information collected gave a broad panorama of issues regarding the context of the city and its particularities.

Acknowledgments

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