Periódico Eletrônico Fórum Ambiental da Alta Paulista
Electronic Journal Environmental Forum of Alta Paulista
ISSN 2966-2931 Suporte Online / Online Support - ISSN 1980-0827 Suporte CD-ROM / CD-ROM Support
Edição em Português e Inglês / *Edition in Portuguese and English* - v. 21, n. 1, 2025

Public Transportation challenges in the Context of the Northwest Metropolitan Corridor of Campinas/SP

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Submissão: 13/06/2025
Aceite: 14/07/2025
FERREIRA, Denise Helena Lombardo; SANTOS, Rodrigo Maia; SUGAHARA, Cibele Roberta; CONTI, Diego de Melo; QUARESMA, Cristiano Capellani. Desafios do Transporte Público no contexto do Corredor Metropolitano Noroeste de Campinas/SP. **Periódico Eletrônico Fórum Ambiental da Alta Paulista**, *[S. l.]*, v. 21, n. 1, 2025.
DOI: 10.17271/1980082721120255777. Disponível em: https://publicacoes.amigosdanatureza.org.br/index.php/forum_ambiental/article/view/5777.

Periódico Eletrônico Fórum Ambiental da Alta Paulista
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ABSTRACT

Objective – To analyze the effectiveness of the Northwest Metropolitan Corridor of Campinas/SP as a public policy aimed at contributing to the resolution of urban mobility issues in the Metropolitan Region of Campinas, as well as its alignment with Sustainable Development, focusing on Sustainable Development Goal 11, target 11.2.

Methodology – Exploratory with a qualitative approach. Regarding technical procedures, the research is documentary with a case study strategy. Data collection was conducted through semi-structured interviews with managers of public institutions in municipalities served by the Northwest Metropolitan Corridor of Campinas/SP. Content Analysis was the technique adopted for analyzing the interviews.

Originality/Relevance – The knowledge produced by this study can contribute as a subsidy for strategies and actions aimed at accessibility and urban mobility for the population of the Northwest Metropolitan Region of Campinas.

Results – It was possible to identify that the integration between intermunicipal and municipal public transportation services becomes essential for the Northwest Metropolitan Corridor of Campinas/SP to reach full operation, however, integration faces challenges considering the difficulty of alignment between the actions planned by the government of the state of São Paulo and the municipalities that make up the Northwest Metropolitan Corridor of Campinas/SP.

Theoretical/Methodological Contributions – Among the theoretical contributions of this study, the discussion based on scientific literature regarding the mobility and accessibility of public transportation users in the municipalities that make up the Northwest Metropolitan Corridor of Campinas/SP (CMNC). stands out. A methodological contribution enabled by the field research was the engagement through interviews with representatives from EMTU and municipal governments served by the CMNC, whose data, collected from these interviews, were analyzed using the Content Analysis technique.

Social and Environmental Contributions – Urban mobility issues have worsened in recent years due to intense population growth and new individual habits. Urban mobility and accessibility are part of the range of public policies aimed at ensuring the well-being of the population.

KEYWORDS: Sustainable transportation. Public policies. Accessibility. Urban mobility.

Desafios do Transporte Público no contexto do Corredor Metropolitano Noroeste de Campinas/SP

RESUMO

Objetivo - Analisar a efetividade do Corredor Metropolitano Noroeste de Campinas/SP como política pública destinada a contribuir para a resolução dos problemas de mobilidade urbana na Região Metropolitana de Campinas, bem como seu alinhamento em relação ao Desenvolvimento Sustentável, com foco no Objetivo de Desenvolvimento Sustentável 11, meta 11.2.

Metodologia - Exploratória com abordagem qualitativa. Em relação aos procedimentos técnicos a pesquisa é documental com estratégia de estudo de caso. A coleta de dados foi realizada a partir de entrevistas semiestruturadas junto aos gestores das instituições públicas de municípios atendidos pelo Corredor Metropolitano Noroeste de Campinas/SP. Para a análise das entrevistas foi adotada a técnica de Análise de Conteúdo.

Originalidade/relevância - O conhecimento produzido por este estudo pode contribuir como subsídio para estratégias e ações voltadas à acessibilidade e mobilidade urbana da população da Região Metropolitana Noroeste de Campinas.

Resultados - Foi possível identificar que a integração entre os serviços de transporte público coletivo intermunicipal e municipal torna-se imprescindível para que o Corredor Metropolitano Noroeste de Campinas/SP alcance o pleno funcionamento, entretanto, a integração enfrenta desafios considerando a dificuldade de alinhamento entre as ações previstas pelo governo do estado de São Paulo e os municípios que compõem o Corredor Metropolitano Noroeste de Campinas/SP.

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Contribuições teóricas/metodológicas - Dentre as contribuições teóricas do trabalho se destaca a discussão a partir da literatura científica sobre a mobilidade e a acessibilidade dos usuários do transporte público dos municípios que compõem o Corredor Metropolitano Noroeste de Campinas/SP (CMNC). Uma contribuição metodológica possibilitada pela pesquisa de campo foi o envolvimento a partir de entrevistas com representantes da EMTU e das Prefeituras dos municípios atendidos pelo CMNC, cujos dados foram analisados a partir da técnica de Análise de Conteúdo.
Contribuições sociais e ambientais - Os problemas de mobilidade urbana têm se agravado nos últimos anos devido ao intenso crescimento populacional e aos novos hábitos dos indivíduos. A mobilidade urbana e a acessibilidade fazem parte do rol de políticas públicas com a finalidade de garantir o bem-estar da população.

PALAVRAS-CHAVE: Transporte sustentável. Políticas públicas. Acessibilidade. Mobilidade urbana.

Desafios del Transporte Público en el contexto del Corredor Metropolitano Noroeste de Campinas/SP

RESUMEN
Objetivo – Analizar la efectividad del Corredor Metropolitano Noroeste de Campinas/SP como política pública orientada a contribuir a la resolución de los problemas de movilidad urbana en la Región Metropolitana de Campinas, así como su alineación en relación al Desarrollo Sostenible, con enfoque sobre el Objetivo de Desarrollo Sostenible 11, meta 11.2.
Metodología – Exploratoria con enfoque cualitativo. En cuanto a los procedimientos técnicos, la investigación es documental con una estrategia de estudio de caso. La recolección de datos se realizó a través de entrevistas semiestructuradas con gestores de instituciones públicas de municipios atendidos por el Corredor Metropolitano Noroeste de Campinas/SP. Para analizar las entrevistas se adoptó la técnica de Análisis de Contenido.
Originalidad/Relevancia – El conocimiento producido por este estudio puede contribuir para apoyar estrategias y acciones orientadas a la accesibilidad y movilidad urbana de la población de la Región Metropolitana Noroeste de Campinas.
Contribuciones Teóricas/Metodológicas – Entre las contribuciones teóricas del trabajo se destaca la discusión basada en la literatura científica sobre la movilidad y accesibilidad de los usuarios del transporte público en los municipios que componen el Corredor Metropolitano Noroeste de Campinas/SP (CMNC). Un aporte metodológico posibilitado por la investigación de campo fue la participación de representantes de la EMTU y de las Prefecturas de los municipios atendidos por el CMNC, cuyos datos fueron analizados mediante la técnica de Análisis de Contenido.
Contribuciones Sociales y Ambientales – Los problemas de movilidad urbana se han agravado en los últimos años debido al intenso crecimiento demográfico y los nuevos hábitos de los individuos. La movilidad urbana y la accesibilidad forman parte del listado de políticas públicas encaminadas a garantizar el bienestar de la población.

PALABRAS CLAVE: Transporte sostenible. Políticas públicas. Accesibilidad. Mobilidad urbana.

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1 INTRODUCTION

The limitations of natural resources in meeting the population's needs have fostered an increased awareness of planetary sustainability. Public transportation, seen as a tool used by the population, aims to facilitate mobility for economic survival and other related activities — such as study, health, and leisure. The accessibility promotes opportunities for education, work, leisure, and social and economic well-being, as it's crucial for human needs across all dimensions of well-being to be met in a balanced way (Moraes, 2017; Helne, 2021).

According to Pedro, Silva, and Portugal (2017), the growing concern for sustainability has driven changes in urban transportation and mobility planning, focusing on accessibility and urban development. Pisoni *et al.* (2019) clarify that urban air quality can be improved by implementing consistent sustainability actions outlined in municipal urban mobility plans.

The disorderly growth of cities has led to an increase in private vehicle and, as Silva and Martinez (2022) highlight, the significant increase in vehicle fleets, particularly in metropolitan areas, has compromised the quality of urban mobility.

The precariousness of public transportation services reinforces the use of individual transport (European Commission, 2020), this phenomenon is observed in Brazil with the growing use of individual transport to the detriment of public transport (Pereira *et al.*, 2021), leading to disastrous economic, environmental, and social problems, as it results in atmospheric pollution due to its reliance on fossil fuels (Santos *et al.*, 2024).

It's notable that the increased commuting time, as observed in recent decades, is a consequence of the expanding car fleet, coupled with the resulting deterioration of urban mobility conditions, which exacerbates traffic congestions (Pereira *et al.*, 2021; Pastorio; Almeida; Neckel, 2023).

According to an urban mobility survey conducted by the National Transport Confederation (CNT) in partnership with the National Association of Urban Transport Companies (ANTU), cities and metropolitan regions face challenges ranging from road planning failures to urban mobility complexities, with transportation identified as the fourth largest urban problem (Santos, 2021). Obviously, these conditions highlight the need for a new urban mobility concept that considers sustainability.

Urban mobility, present in the 2030 Agenda formulated by the UN, along with Sustainable Development Goals - (SDG) 11, Target 11.2, aims to provide access to safe, affordable, accessible, and sustainable transport systems, improving road safety by expanding public transport, with special attention to the needs of people in vulnerable situations (United Nations, 2015).

It's important to note that Target 11.2 isn't achieved solely through the development of urban mobility policies.

For Leite (2023), urban mobility should be a right and a means to achieve other rights, as it's fundamental for a productive, dignified, and healthy life. However, Pedro, Silva, and Portugal (2017) point out that the complexity of transportation problems, including deficient infrastructure, chronic congestion, air and noise pollution, and a high incidence of accidents, demands urgent and effective solutions in the developing world, a scenario repeated in Brazil. Additionally, Rosa *et al.* (2022) highlight that prioritizing motorized travel contributes to

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increased vehicle congestion, which exacerbates physical and mental health problems caused by the emission of polluting gases.

Siqueira, Lima, and Santos (2021) emphasize that in the absence of an urban mobility policy, transportation and urban mobility projects and actions often rely on empirical knowledge and sometimes lack predefined criteria. So *et al.* (2023) highlight the importance of public policies in addressing municipal mobility and accessibility issues.

Based on the premise that urban mobility and accessibility are part of the public policies conducted by authorities to ensure the population's well-being, especially for inter-municipal public transport users, this research analyzes urban mobility from the perspective of the Northwest Metropolitan Corridor of Campinas/SP as an alternative solution for the mobility challenges of the involved cities, as well as the highways connecting these cities, considering the social, environmental, and economic impacts.

Given the need to ensure public access to services and professional activities in the Campinas Metropolitan Region, as well as the universalization of public transport, coupled with the need to create mobility alternatives, the State Government of São Paulo, through the Metropolitan Transport Department, began implementing the Northwest Metropolitan Corridor of Campinas/SP in mid-2006.

In 2006, prior to the National Urban Mobility Policy, the State Government of São Paulo, through the Metropolitan Urban Transport Company of São Paulo (EMTU), after studies related to the Metropolitan Road System of Interest (SIVIM), formulated the project for the Northwest Metropolitan Corridor of Campinas/SP (CMNC), aiming at optimizing the public transport system, reduce the metropolitan bus fleet, and consequently decrease congestion on the highways connecting the cities in the Campinas, Hortolândia, Sumaré, Nova Odessa, Americana, and Santa Bárbara d'Oeste region through the creation of exclusive bus lanes, integration between inter-municipal and municipal public transport services, construction of transfer terminals, and the adoption of new technologies in public transport.

2 METODOLOGY

This research is characterized as exploratory, documentary, and bibliographic employing a qualitative approach and field research. The bibliographic research was conducted using national and international literature related to the themes: public policy, urban mobility, accessibility, and public transport.

Regarding technical procedures, the research is documentary. The sources used were: the National Urban Mobility Policy (PNMU), Law No. 12,587/2012 (Brazil, 2012), and the 2030 Agenda which outlines the Sustainable Development Goals established by the United Nations (United Nations Brazil, 2015). Additionally, information was collected from the websites of the municipalities involved with the Northwest Metropolitan Corridor of Campinas/SP (CMNC), the São Paulo State government, and the Metropolitan Urban Transport Company (EMTU).

The research adopts a case study strategy, focusing on the Northwest Metropolitan Corridor of Campinas/SP under the management of the Metropolitan Urban Transport Company of São Paulo (EMTU). According to Yin (2010, p. 24), case studies are used in research that seeks to understand "individual, group organizational, social, political phenomena".

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As this research addresses factors related to the use of metropolitan public transport, the individual technical knowledge of the research participants regarding the original CMNC project was considered, along with documentary information in line with Gil's (2019) position.

In-person interviews were conducted with representatives of EMTU and the city halls of the municipalities served by the CMNC, with the exception of Sumaré, which did not respond after contact attempts. Participants were designated as E1, E2, E3, E4, E5, and E6. According to Yin (2010), field research requires the researcher to acknowledge that some events are beyond the researcher's control.

Regarding the profile of the research participants, all interviewees hold or have held management positions related to public transport at both municipal and inter-municipal levels and possess higher education.

The research was approved by the Human Research Ethics Committee (CEP) in November 2022, under protocol no. 5,775,750. The interviews aimed to capture participants' experiences, opinions, feelings, and values, as well as their understanding related to the Northwest Metropolitan Corridor of Campinas/SP as a public policy.

2.1 Northwest Metropolitan Corridor of Campinas/SP – CMNC

The municipalities of Hortolândia, Sumaré, Monte Mor, Nova Odessa, Americana, and Santa Bárbara d'Oeste comprise the Northwest Region of the RMC (Campinas Metropolitan Region). The disorderly growth of Monte Mor and Sumaré since the 1980s, and Hortolândia from the 1990s onward, led to the opening of irregular land subdivisions with low urban land value, attracting low-income populations. This physical-territorial expansion, originating from Campinas, is a result of horizontal expansion dynamics, with discontinuous spaces motivated by land subdivision and discrepancies in land prices (Cunha *et al.*, 2016).

The population increase in the municipalities comprising the Northwest Region of Campinas, significantly represented by low-income populations, has made these cities suppliers of less qualified labor for the entire region, especially Campinas, being such population majority users of inter-municipal public transport, accounting for 75% of the total regional demand (EMTU, 2006).

With the disorderly growth of cities, difficulties arise from regional urban mobility, such as increased demand for inter-municipal transport, higher vehicle flow on regional highways, and undesirable traffic congestions.

Regarding inter-municipal public transport, the reflection is seen in overcrowding due to an insufficient number of vehicles relative to user demand, poor fleet maintenance, and itineraries that don't match user needs.

According to EMTU (2006), the initial forecast for the operation of the Northwest Metropolitan Corridor of Campinas/SP was 2007. However, the CMNC only began in 2009, in fragmented micro-basins, with an extension of 32.7 km, including 7 km of exclusive bus lanes, with benefits including a high expansion in the supply of trips between municipalities, reduced travel time, increased safety, and decreased greenhouse gas emissions.

The primary function of the CMNC is to facilitate mobility and accessibility for public transport users among its constituent municipalities which can be understood as three micro-basins; Santa Bárbara d´Oeste/Americana/Nova Odessa; Sumaré/Nova Odessa/Hortolândia; and Hortolândia/Sumaré/Campinas (EMTU, 2006).

It's important to emphasize that the implementation of the CMNC requires the participation and involvement of each municipality, as well as authorization for the respective

works to adapt municipal roads, coupled with the indispensable need for consensus among municipal authorities and State Government representatives, with EMTU's participation.

2.2 Data Treatment and Analysis Technique

Data treatment involved content analysis of the research participants' statements to develop categories. The initial impressions and expectations from the interviews emerged in terms that form the categories and subcategories related to the CMNC's implementation, considering the interviewees' statements and the participants' operational technical knowledge.

To gain a better understanding of the expected outcome, categorization was chosen as the instrument for results analysis, since according to Bardin (2016), Content Analysis based on categorization allows for the fidelity of the intended information. As Carlomagno and Rocha (2016) emphasize, the reliability of categorization lies in the impossibility of redundancy, as well as the impossibility of element repetition.

Based on the terms present in the CMNC project and grounded in the literature, the necessary actions for the realization of the themes comprising the initial research categories were identified.

The creation of the research categories/subcategories was performed based on the responses obtained in the interviews, following the guidance of Silva and Fossá (2015) and Bardin (2016). In establishing categorization as a results analysis method, the themes of Public Policy and Sustainable Development were included, as they are related to public collective transport. The data treatment of the research allowed for the creation of the following categories/subcategories: Public Policy - Public Transport, Urban Mobility, Urban and Regional Planning, Accessibility; and Sustainable Development - Environmental, Social, and Economic dimensions.

3 RESULTS AND DISCUSSIONS

The analysis of the results was elaborated considering the content of the CMNC project, the set of words extracted from interviews with public managers, and the literature on the research topic.

3.1 Category – Public Policy

Urban mobility is part of the conditions for social well-being, being implemented when public authorities create mechanisms to guarantee citizens' right to accessibility. In this research, accessibility is treated as encompassing all people, including the elderly and those with reduced mobility. According to Oliveira and Mill (2016, p. 1171), " accessibility is supported by the pursuit of equality for all and is closely related to the term of inclusion". Regarding accessibility, interviewee E1 states that "the Metropolitan Corridor, implemented in its full extension, will ensure the right to accessibility for public transport users in the cities that comprise the Metropolitan Corridor."

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The serious problems related to urban mobility in the Campinas Metropolitan Region imposed the adoption of public policies in the context of public collective transport, aiming to ensure accessibility and consequently reduce traffic congestion.

The public policy regarding public transport adopted by the State Government of São Paulo originated in 2005 with the CMNC project, even before the PNMU was enacted, aligned with the guidelines provided by SIVIM, encompassing several actions with an expected operation start in November 2007, among which, improving user comfort conditions at new terminals and transfer/boarding/disembarking terminals; reducing the average age of the fleet and travel time; expanding travel offerings; electronic control system; single fare; increasing the number of direct lines between municipalities with more destination options; and constructing bike paths and walking trails (EMTU, 2006).

The failure to meet all the objectives outlined for the CMNC can be observed from the interviewees' statements: E3 - "the need to change the original route forced the interruption of works in the municipality"; E1 - "the various difficulties faced by local administrations in authorizing the progress of works led to its fragmentation." For interviewee E3, the delay in implementation is also justified by the need for changes in the initially designed route, as "the Metropolitan Corridor's route in the municipality was initially planned through one avenue and, later, due to the municipal development plan, the route changed to another avenue." In addition, interviewee E3 argued, "the change brought greater meaning to the municipality's transport system in harmony with metropolitan transport, given the inclusion of public transport in a densely populated area". To address the challenges of urban expansion, an Urban Mobility Plan should be developed, involving the identification of demands related to transport modes, road conditions, among others, with the aim of ensuring people's accessibility.

Regarding the delay in CMNC implementation, interviewee E1 also reports, "the change in the original route, that is, the initial proposal was to invest in avenues already used by public transport in densely populated areas, as well as following the habit of transport users (the 'ant path')". The issue of delay in CMNC implementation was also mentioned by interviewee E4 when commenting that it "caused the original objectives of the Metropolitan Corridor to be disfigured, requiring new planning to encourage users to use the Metropolitan Corridor", motivating the delay in CMNC implementation works.

The difficulty of consensus due to constant changes in government is highlighted by interviewee E6, "so far, the Metropolitan Corridor does not serve as a transport service proposal for the municipality", and continues, "I have been in this position since January 2021, and there has been no contact from managers to inform about the purpose of the Metropolitan Corridor". On this aspect, interviewee E4 observes, "changes at the state level caused a hiatus during the initial four years of the Metropolitan Corridor construction project". The changes in municipal and state governments resulted in a discontinuation of actions related to the works and also to the integration and implementation of the system.

Araújo *et al.* (2011) argue that public transport is responsible for democratizing urban mobility, becoming essential and indispensable, with the added benefits of reducing the need for road and parking construction, lessening traffic congestion, and providing environmental gains. Regarding the importance of urban mobility as a guarantee of access, interviewee E3 emphasizes, "the Metropolitan Corridor proposes guarantees of access, provided there is

consensus and understanding among managers regarding its importance as a means of transport".

3.1.1 Subcategory – Public Transport

The PNMU includes public collective transport in the scope of public policies, defining it as a public service accessible to the entire population through individualized payment (Brazil, 2012). When considering the importance of treating public transport as a public policy, interviewee E3 notes, "public transport is the way to significantly reduce traffic congestions". By providing equipment and services related to mobility, there can be an increase in metropolitan public transport users and a decrease in private vehicle fleets and traffic congestions.

It is state government's responsibility to provide inter-municipal urban public transport services (Brazil, 2012). Within the RMC limits, the provision of inter-municipal collective transport occurs through permission granted to a third-party company, with management being the responsibility of the Metropolitan Urban Transport Company (EMTU).

According to Sousa (2015), public transport service provision occurs based on certain requirements, such as vehicle fleet, punctuality, and itinerary. Regarding the fleet, Sousa (2015) clarifies that aspects such as technology use and useful life constitute quality characteristics in the provision of public collective transport services. Regarding the public transport vehicle fleet involving the CMNC, interviewee E6 comments, "it becomes impossible to evaluate such requirements due to the lack of connection in the provision of public transport services between urban and metropolitan transport", for interviewee E1, "the bidding for the metropolitan transport service concession requires the offering of a quality bus fleet, technologies like free internet, air conditioning, and a useful life of a maximum of five years". The quality related to information technology contributes to better user accommodation.

Punctuality, understood as regularity, is presented as a requirement for public transport service provision, although not contemplated in the CMNC implementation project. In interviewee E4's view, "the non-implementation of the integrated system of the Metropolitan Corridor makes the system underutilized and, therefore, unable to evaluate its punctuality". Along the same lines, interviewee E3 adds, "the punctuality of public transport through the Metropolitan Corridor will only be observable after the integrated system begins operation". It is important to note that punctuality is one of the factors that contributes to the reliability of public collective transport service provision.

It is observed that when using the fare as a financing instrument for the urban transport system, it is necessary to define its importance for people's displacement in urban centers, in this regard, interviewee E1 emphasizes the "inability to maintain the public transport system solely through the fare paid by the user". Interviewee E2 adds about "the need to apply technologies like the single ticket aiming for more accessible and attractive fare prices for the user".

Interviewee E2 further states, "the reality of the Metropolitan Corridor's transport is similar to other regions regarding the need for public incentive through subsidies to maintain public transport services". Therefore, the need for developing new technologies to reduce

operating costs, as well as public financing to ensure free access to the public transport system as mandated by law, is understood.

It is EMTU's responsibility, in consensus with the involved municipalities, the itinerary planning, within the scope of the CMNC. Reck (2015) emphasizes that the itinerary is a requirement for public transport, given the need for displacement between origin and destination, including time and route, according to user convenience. Interviewee E4 observes, "although the Metropolitan Corridor has its predefined itinerary, its effectiveness will only occur when the inter-municipal transport system and municipal transport are integrated". The lack of integration between the municipal and inter-municipal systems compromises the CMNC's effectiveness in providing users with an itinerary that serves as a link between origin and destination.

3.1.2 Subcategory – Urban Mobility

The urban mobility discussed in this section considers infrastructure, meaning the quality of roads - streets, avenues, bridges, overpasses, pedestrian bridges, among others; connection between road networks; harmony between traffic lanes, terminals, and transfer stations and between various modes - active transport, individual transport, and public transport.

Problems related to urban mobility, such as: accessibility failures, traffic congestions, and noise and air pollution, which arise as a reflection of disorderly growth and lack of urban planning, as well as the inefficiency of public collective transport, contribute to what Pereira *et al.* (2021) describe as disastrous economic, environmental, and social disturbances. Regarding urban mobility, interviewee E3 reports that "the Metropolitan Corridor's route respects urban road conditions and can provide better mobility conditions for cities".

The original CMNC implementation project proposed a route utilizing existing road networks already used by public transport services (EMTU, 2006). Along this line, interviewee E1 observes, "the original Metropolitan Corridor project envisioned the use of avenues and streets in each municipality, as well as the flow utilized by inter-municipal public transport system users in each municipality". In this regard, the suggested and demanded adaptations in each municipality required changes in the route, with the opening of new avenues, making the connection between the CMNC and the access roads of each municipality complex. On this, interviewee E2 highlights, "the change in the route was due to the need to create access opportunities and facilitate the lives of users in a specific area of the city, which benefited the entire city".

The CMNC implementation works demand the involvement of municipal authorities, considering the interests of residents and businesses in the CMNC's vicinity, as well as the specific development plans of each municipality. Since 2008, these works have followed architectural planning, encompassing user safety and accessibility conditions (Brazil, 2008).

The original CMNC proposal contemplates the articulation between metropolitan transport and local transport modes, translated into municipal public transport, individual transport, and active transport. Regarding the integrated functioning of the municipal and inter-municipal public transport systems, a lack of connection between transport systems is observed

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in all municipalities covered by the CMNC. In this context, interviewee E3 observes the "difficulty of advancing with the implementation of the Metropolitan Corridor system by the municipalities and the São Paulo state government". Along the same line, interviewee E2 emphasizes, "the integrated system will occur according to the organizational conditions of each municipality".

3.1.3 Subcategory – Urban and Regional Planning

Based on SIVIM studies, the State Government of São Paulo proposed the planning, investment, and maintenance of the CMNC through an agreement with the municipalities comprising the Northwest Region of the RMC, with public collective transport services provided through permits to outsourced companies. On this, interviewee E4 emphasizes, "The Metropolitan Corridor occurred under SIVIM's guidance without the intention of taking the user from one extreme to another, but rather facilitating access between conurbated municipalities". Although the corridor only covers six municipalities, the intention is to make life easier for public transport users who use the CMNC system between municipalities.

To serve public transport, the CMNC's original route was designed using existing streets and avenues in the municipalities, whereas investments in road infrastructure, as well as the installation of transfer stations and terminals were made through an agreement between the state government and the municipalities based on dialogues with the local community, especially residents and businesses located around the CMNC. Along this line, interviewee E5 states, "only after the implementation of the Metropolitan Corridor services will it be possible to evaluate its effectiveness as a public transport system proposal".

The original CMNC project, by utilizing existing avenues and streets, eliminates the need for expropriations, as well as the need for interventions in urban road networks, avoiding any alteration to the existing local urban planning. Silveira and Cocco (2013) highlight that, in the Brazilian context, the implementation of urban infrastructure associated with collective transport, whether bus corridors or rail systems, involves high costs of expropriation and other related expenses. On this, interviewee E1 observes, "the original project avoided expropriation costs, with municipalities bearing the costs of such expropriations, in the event of a need to change the route within the limits of each municipality", and interviewee E2 highlights, "the costs of expropriations due to changes in the Metropolitan Corridor's route were the responsibility of the municipality".

The implementation of a public transport system requires planning and the development of urban land use legislation (Silveira & Cocco, 2013). For interviewee E1, "it is necessary to develop public collective transport policies in each municipality so that the Metropolitan Corridor can finally have its operation effective, even if in a fragmented way".

3.1.4 Subcategory - Accessibility

For Pereira and Herszenhut (2023), accessibility is the result of local transport and urban development policies, whose objective is to provide individuals with access to employment opportunities, public, cultural, and leisure services, among others.

Among the actions planned for the CMNC, accessibility is related to comfort and road infrastructure. In this direction, interviewee E1 emphasizes, "the Metropolitan Corridor project includes the installation of equipment that contributes to the access for people with reduced mobility". One can observe signage for visually impaired people on station sidewalks, handrails on platforms, access ramps, and elevators. For the interviewees, the CMNC presents itself as a tool for inclusion in public transport. Luiz and Teixeira (2016) highlight that the installation of safety-related equipment for mobility makes spaces more accessible.

The use of technologies that contribute to access for people with reduced mobility, i.e., the elderly and people with disabilities, is present in the CMNC's infrastructure and vehicle fleet. According to Turbay and Firmino (2023), accessibility levels are complemented through transport technologies. In this sense, interviewee E1 emphasizes, "the entire Metropolitan Corridor project considers the use of technologies that guarantee accessibility for people with reduced mobility". By ensuring access for people with reduced mobility, the CMNC adheres to the principle of equity in citizens' access to public collective transport, as stated in Article 5, item III of the PNMU (Brazil, 2012).

To promote accessibility, the CMNC project highlights the elimination of steps on buses and the leveling between the boarding platform and the bus, which facilitates access for people with disabilities and reduced mobility. For interviewee E2, "the works on the terminals and transfer stations are completed, and the concept of accessibility is also included". For interviewee E4, "the effects of the accessibility proposal will only become noticeable when the system operates in an integrated manner between municipal and inter-municipal transport".

3.2 Category - Sustainable Development

The themes of Public Policy and Sustainable Development are intrinsically related to urban planning, urban mobility, accessibility, and public transport, producing environmental, social, and economic impacts.

The actions foreseen for the CMNC, aiming for less use of fossil fuels, improved access, valorization of the CMNC's surroundings, increased resident self-esteem, affordable fares, and new businesses, are strategic actions to meet Target 11.2 of SDG 11, with perceptible environmental, social, and economic impacts.

Although the objectives intended with the implementation of CMNC services are significant, what is observed is the underutilization of services regarding the intention to make the CMNC an effective public policy and the achievement of environmental, social, and economic objectives. Furthermore, there has been a discontinuity in the CMNC's implementation efforts, at both municipal and state levels, and constant changes in municipal managers.

3.2.1 Subcategory – Environmental Dimension

Urban mobility, particularly individual transport, is one of the main emitters of polluting gases. Barczak and Duarte (2012) highlight that the increase in private motorization contributes to the worsening of Greenhouse Gas (GHG) emissions. In this regard, interviewee E3

emphasizes, "large-scale individual transport use in urban centers causes traffic congestion, noise pollution, and air pollution".

Anthropogenic actions have caused serious problems, especially in the transportation sector in urban areas, given the extensive use of road vehicles such as cars, buses, trucks, and motorcycles, being the major sources of pollution because they are predominantly fueled by fossil fuels. Among the health problems related to respiratory health, chronic bronchitis stands out (Saldiva, 2018). Additionally, noise pollution has negative health effects.

In 2022, the individual vehicle fleet, in the Northwest Region of the RMC, reached a total of 1,194,550 cars and 223,576 motorcycles (Brazil, 2022), compared to a population of 2,137,109 inhabitants (IBGE, 2023). The public collective transport fleet in the Northwest Region of the RMC consists of 193 buses distributed across 65 bus lines, transporting 70% of all public collective transport users in the RMC (EMTU, 2023). These numbers demonstrate the importance of implementing the CMNC for actions that lead to a reduction in GHG emissions.

Implemented in 2006, the CMNC introduces a series of innovations related to metropolitan transport and, even while implicitly maintaining GHG emission reduction targets, its environmental impact is noticeable, according to EMTU (2006), the proposal includes a 20% reduction in the fleet, 30% in bus lines, and 30% in kilometers traveled, which enables the equalization of the metropolitan transport system. Interviewee E2 highlights, "The system equalization proposals, combined with the use of technology, increased comfort, and accessibility conditions, reflect greater reliability, encouraging the shift from individual transport to public transport". According to interviewee E2, "the implementation of the CMNC system and the migration from individual transport to public collective transport will contribute to reducing traffic congestion, and fossil fuel consumption will be alleviated and, consequently, mitigating air and noise pollution". Interviewee E5 emphasizes "the need for integration between municipal and inter-municipal public transport systems for the effective achievement of proposals to reduce the collective transport fleet, as well as to decrease air and noise pollution".

3.2.2 Subcategory – Social Dimension

Ensuring the eradication of extreme poverty and human rights for all, achieving gender equality, and empowering women and girls are indispensable requirements for the sustainable development, as outlined in the 2030 Agenda (United Nations Brazil, 2015). The universal adoption of the 2030 Agenda represents a strong signal of global interest in economic, social, and environmental integration, in pursuit of substantial improvements in public health and social well-being (Moallemi *et al.*, 2019).

The analysis of the social impact obtained from the CMNC's implementation is based on the premise of integration between municipal and inter-municipal public transport systems, foreseeing the revitalization of the road network with the creation of exclusive lanes, constructing transfer and boarding/disembarking terminals with modern architecture, landscaping and lighting, all designed with engineering for the inclusion of people with disabilities and reduced mobility. Regarding the inclusion promoted by the CMNC, interviewee E2 highlights, "families residing near the Metropolitan Corridor feel valued". For interviewee E4, "the Metropolitan Corridor brought development to areas that were peripheral and where

development would hardly have reached". Among the benefits generated by the CMNC, interviewee E3 emphasizes that "improving the quality of public collective transport becomes a social gain". Indeed, public works and services contribute significantly to people's quality of life, thereby, reflecting social gains.

The social impact, related to people's access through public transport achieved with the CMNC, is present in the adaptations of public equipment such as terminals, sidewalks, and buses, which enable the transit of the elderly and people with disabilities. In this vein, interviewee E1 observes, "the works and projects of the Metropolitan Corridor system are in accordance with legislation and contemporary mobility proposals, favoring the inclusion of people with disabilities and reduced mobility, as well as the democratization of accesses". Interviewee E5 points out the "need for adaptations of the municipal public transport system to truly achieve the accessibility aimed for by the Metropolitan Corridor". According to the interviewees' reports, the CMNC's operation contributes to the inclusion and respect for the access of people with disabilities and reduced mobility to the transport system.

3.2.3 Subcategory – Economic Dimension

The need for people's displacement by transport, whether individual or collective, accounted for 14.4% of the household budget in Brazil in 2018, according to the Household Budget Survey (POF) (IBGE, 2018). It's important to note that public transport's share of this total is 1.3%, thus demonstrating the high cost of individual transport in the household budget. Private vehicles can provide individual well-being; however, from the perspective of urban quality of life, the negative externalities outweigh the benefits, taking as an example the compromise of the functioning of cities, an increase in traffic accident deaths, among other factors such as air and noise pollution, in addition to traffic congestions, as already mentioned, consistent with Araújo *et al.* (2011) who state that the use of individual transport results from inadequate collective transport offerings, which favors increased pollution and traffic congestion.

For the effectiveness of the actions and expected results with the CMNC's implementation, the integration between the municipal public transport system and metropolitan public transport favors fleet reduction, as well as reduced operating costs, reflecting in a greater supply of public transport services and a fare decrease (EMTU, 2006). Given this, interviewee E1 observes, "the cost of the transport system in all municipalities that make up the Northwest Region of the RMC tends to decrease with the implementation of the Metropolitan Corridor."

The integration between the municipal public collective transport system and the inter-municipal public collective transport system allows for the implementation of an electronic ticketing system and the subsequent implementation of the single ticket; that is, when boarding the municipal transport system, the user pays the fare related to the municipal system, and when boarding the inter-municipal system, pays the difference between the fares. As interviewee E2 points out "the single ticket is an effective way to lower public transport costs, already implemented in São Paulo city" Interviewee E4 adds "among the benefits, the integration between municipal and inter-municipal public collective transport systems can allow

for cheaper fares". The interviewees highlight the importance of integration between municipal and inter-municipal public transport systems for the proper implementation of the single ticket and the consequent reduction in fare prices, which leads to positive economic impacts for the population.

Additionally, the CMNC promotes greater circulation of public collective transport users near transfer, boarding, and disembarking stations, enabling the establishment of businesses around the CMNC and, consequently, generating employment and income, as well as greater consumption opportunities. According to Zhan (2022), it is undeniable that a higher level of product consumption by the population favors the feeling of human well-being. Regarding businesses around the CMNC, interviewee E2 comments "several businesses were established after the Metropolitan Corridor works". This is the same perception of interviewee E5 "even without the operation of the Metropolitan Corridor system, several businesses have been established".

4 FINAL CONSIDERATIONS

The quality of life in a city or metropolitan region is directly related, among other factors, to urban mobility and accessibility conditions. Over decades, public collective passenger transport has become the primary mode of transport for the lower-income population, prompting immediate government actions in granting public transport services, creating new bus lines, and expanding municipal and state bus fleets, all contributing to the formulation of urban mobility and accessibility policies.

Difficulties related to mobility in urban centers, coupled with failures in the provision of public collective transport services and the massive use of private vehicles in metropolitan regions result in traffic congestions driven by competition for public roads between public and private transport vehicles.

Among the initial objectives of the Northwest Metropolitan Corridor of Campinas/SP (CMNC), one can cite the optimization of public collective transport services, with an increase in the number of faster trips, in addition to a reduction in the inter-municipal public collective transport fleet. However, after the start of CMNC implementation, the underutilization of services due to the lack of integration between municipal and inter-municipal public transport systems is observed.

Urban traffic is one of the biggest contributors to GHG emissions and global warming. Thus, the effective functioning of the CMNC remains a public policy of extreme importance to optimize and establish public collective transport as the main mode of transportation. It is believed that such actions will stimulate a reduction in pollutant emissions and, consequently, a decrease in air and noise pollution (environmental dimension), create opportunities for new businesses, and encourage new ventures, generating employment (economic and social dimensions), as a strategic instrument envisioned in Target 11.2 of the SDGs.

This research identifies the difficulty of consensus between state and municipal managers regarding the understanding of the CMNC's importance, either due to the difficulty of initiating CMNC installation works, as in the city of Sumaré, or the difficulty of implementing

integrated transport services between inter-municipal and municipal public transport, even in municipalities where CMNC works are completed.

Based on the information obtained from the interviewed participants in this research and from visits to bus terminals in the CMNC municipalities, difficulties were observed in the full implementation of CMNC services and equipment in full and in achieving the intended objectives.

Given the significant governmental investments in infrastructure and technology, coupled with the underutilization of CMNC services, future research needs to investigate the effectiveness of using the CMNC as a priority for improving transport, considering the high value invested in its implementation.

An opportunity for future research identified by this study lies in the need to measure the quantity of GHG emissions for each type of collective or individual transport, given that there have been few advancements from a social and environmental perspective for the implementation of inter-municipal public collective transport oriented towards sustainability. Furthermore, for future research, it would be interesting to include public transport users and the population surrounding the CMNC in order to obtain a more accurate representation of the experienced reality.

ACKNOWLEDGMENTS

This work was supported by the Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES) – Funding Code 001.

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Periódico Eletrônico Fórum Ambiental da Alta Paulista
Electronic Journal Environmental Forum of Alta Paulista
ISSN 2966-2931 Suporte Online / Online Support - ISSN 1980-0827 Suporte CD-ROM / CD-ROM Support
Edição em Português e Inglês / *Edition in Portuguese and English* - v. 21, n. 1, 2025

DECLARATIONS

CONTRIBUTION OF EACH AUTHOR

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DECLARATION OF CONFLICTS OF INTEREST

We, **Denise Helena Lombardo Ferreira, Rodrigo Maia Santos, Cibele Roberta Sugahara, Diego de Melo Conti e Cristiano Capellani Quaresma**, declare that the manuscript entitled "**Os desafios do Transporte Público no contexto do Corredor Metropolitano Noroeste de Campinas/SP":**

1. **Financial Links:** "No funding institution or entity was involved in the development of this study".
2. **Professional Relations:** "No professional relationship relevant to the content of this manuscript has been established".
3. **Personal Conflicts:** "No personal conflicts related to the content have been identified".