A city-region centered in Bogotá, with mass transit growth extending to 21 municipalities.

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Abstract

This paper presents a comprehensive proposal to improve mobility in the Central Region of Colombia, centered in Bogotá, through international and scientific partnerships. It begins with a diagnosis of the chaos in urban and regional transportation, characterized by traffic congestion, a lack of coordination between municipalities, and uncontrolled urban sprawl. The study proposes sustainable road infrastructure megaproject models, with an emphasis on mass transit, cycle routes, emergency service centers, and road safety strategies. The methodology employs a quantitative approach with surveys of 900 people, data analysis, and a logical planning framework. It highlights partnerships with universities specializing in mobility and urban planning, both in Latin America and Europe, to strengthen the project's technical foundation. It also proposes a dissemination strategy in academic and specialized media. The document emphasizes the importance of inter-institutional collaboration, technological innovation, and citizen participation in addressing mobility challenges. It also addresses topics such as gender-sensitive mobility, the economic impact of traffic chaos, and the need for resilient planning in the face of disruptive events. Overall, the proposal seeks to transform regional mobility with integrated, sustainable solutions focused on citizen well-being.

Keywords: scientific support for road infrastructure, transport chaos, city-region, collaboration in urban planning, crime control in transport, motorcycle mobility culture, mobility difficulties, road dissemination strategy, maintenance of cycle paths and routes, megaproject models, immediate road service posts, constant bicycle traffic.

INTRODUCTION

Urban and regional mobility has become one of the most complex and urgent challenges for Latin American cities in the 21st century. In this context, Bogotá and its metropolitan environment face increasing pressure derived from accelerated population growth, disorderly territorial expansion and limited articulation between municipalities. This situation has generated a scenario of chaos in transport, characterized by constant congestion, deficiencies in road infrastructure, insecurity in the public transport system and a fragmented mobility culture. Faced with this panorama, this document proposes a comprehensive strategy to improve mobility in the Central Region of Colombia, with its epicenter in Bogotá, articulating models of mass transport megaprojects, international scientific alliances and territorial sustainability actions.

The proposal is based on the recognition of the city-region as a functional unit that transcends administrative borders, and that requires coordinated, innovative and sustainable solutions. In this sense, the need to define an adequate mass transport infrastructure that responds to the accelerated growth of the capital and the lag in the development of the surrounding cities is raised. To this end, a methodology based on the deductive approach,

the logical planning framework and data analytics is proposed, with a representative sample of 900 respondents from Bogotá and 20 surrounding municipalities. This empirical base allows the identification of the main difficulties in mobility, the patterns of use of transport and the citizens' perceptions of the quality of service, road safety and accessibility.

One of the central axes of the document is the formulation of models for road connectivity megaprojects that generate sustainable impacts on the economy, the environment and the regional quality of life. These models are inspired by national and international experiences, such as the Medellín Metro, aerial cables in peripheral areas of Bogotá and integrated urban interventions in cities such as Lima, Loja and Monterrey. It is proposed that megaprojects should incorporate criteria of territorial equity, technological innovation, citizen participation and inter-institutional collaboration, avoiding replicating schemes disconnected from local realities. It also highlights the importance of including a gender perspective in urban design, recognizing inequalities in access to and use of transport between women and men.

The document also addresses the need to establish strategic alliances with universities specialising in infrastructure and transport, both in Europe and Latin America, within the framework of the Horizon Europe Programme. These alliances will strengthen the technical base of the project, incorporate scientific support in road design and promote knowledge transfer through studies, consultancies and academic events. The management of these collaborations is structured in clear phases, with verifiable success indicators, such as the identification of partner institutions, the signing of agreements and the start of joint activities.

Another key component of the proposal is the implementation of comprehensive actions for safety, accessibility, and sustainability of transportation. This includes the construction of immediate service posts on main roads, the conditioning of cycle routes and spaces for motorcycles, and the strengthening of road culture through preventive dissemination campaigns. It is proposed that timely attention to accidents, road safety education, and the use of advanced technologies such as sensors, intelligent signage, and innovative pavements, are essential to reduce risks, improve citizen perception, and guarantee the operational efficiency of the system.

Finally, the document stresses that thinking about mobility from a city-region perspective implies overcoming institutional fragmentation and promoting integrated planning. This requires political will, strategic leadership and active citizenship that participates in the co-creation of solutions. Mobility should not be understood only as a technical problem, but as a social, economic and cultural phenomenon that directly affects quality of life, equity and urban sustainability. In this sense, it invites us to imagine new ways of living and moving around the city, adjusting school schedules, encouraging the use of electric bicycles, designing multifunctional neighborhoods and using mobility data to build collaborative solutions.

The proposal presented in this document constitutes a significant contribution to the debate on mobility in Bogotá and the Central Region, offering a comprehensive, evidence-based and action-oriented vision. Its multidisciplinary approach, its international articulation and its commitment to sustainability make it a valuable tool for the transformation of the

transport system and the construction of more connected, safe and equitable territories, by resolving the question: How can a city-region be defined with adequate mass transport infrastructure that allows it to face the accelerated growth of the capital city and the lag in the development of its surrounding cities?

2. OBJECTIVES

General objective

Define the city-region with adequate mass transport infrastructure, to cope with the rapid growth of the capital city in the face of the slow development of the surrounding cities.

Specific objectives

Analyze the historical and current context of chaos in urban and regional transport, identifying the main difficulties in mobility and connectivity between cities, for the formulation of road infrastructure proposals based on megaproject models that respond to the accelerated growth of urban centers.

Design a strategic plan for international and scientific cooperation, establishing alliances with urban planning and mobility entities in Europe and Latin America, as well as with universities specializing in infrastructure and transport, to strengthen the technical base of the project and disseminate its advances in specialized media and academic events.

Implement comprehensive actions for the safety, accessibility, and sustainability of transportation in the Central Region of Colombia, including the construction of immediate service posts on main roads, the conditioning of cycle routes and spaces for motorcycles, and the strengthening of road culture and the effective prosecution of crimes in the transportation system.

3. METHODOLOGY

The deductive type, logical framework for planning, monitoring and evaluation of projects and programs, quantitative approach. Correlational hypotheses, estimation and correlation statistics. Probabilistic methods of correlational scope, in order to study predictions and observation. The technique is a survey with data analytics, a sample calculated on the population of the city central region with the epicenter Bogotá and the Instrument are questionnaires and a log of observations. Resources, 162,000 million euros in 5 phases.

What models of road connectivity megaprojects can be implemented between cities in the Central Region of Colombia that generate sustainable impacts on the economy, the environment and the regional quality of life? Chaos in transportation, city region, connectivity between cities, difficulties in mobility, road infrastructure, macroeconomy. Transportation megaprojects, environmental system, mass transportation. Effective improvement of mobility and transportation in the central region of Colombia with epicenter in Bogotá. More than 30 sustainable and people-friendly road solutions. The universe is made up of mobility and transport users from Bogotá and 20 surrounding municipalities, with the number of inhabitants of 10,306,281, men and women, of different ages, gender, race and socioeconomic strata.

Men and women, all socioeconomic levels at the national and international level, with urban (virtual) coverage, of any profession and occupation. This sampling frame covers

100% of the target group, made up of 900 respondents. Applied Methodology, From the general to the particular, with interaction of the logical framework for the planning, monitoring and evaluation of projects and programs The hypotheses are of a correlational type where dependent and independent variables are taken into account, using estimation and correlation statistics with information from 21 municipalities, in the central region BI Data Analytics. Sample calculated in 900 respondents. The level of confidence taken in this research is 99.6%. Margin of error of 5% The scope is correlational, in which the ground is prepared, associating concepts and variables in order to study predictions, quantifying relationships between causes and effects. 55 questions structured and aligned with the problem statement using the logical framework methodology. with structured forms in Google Drive, taking advantage of the university's installed capacity and licenses with Gmail.

4. RESULTS

Definition of "Central Colombian City"

The "Central Region City of Colombia" is a strategic territorial configuration that articulates Bogotá, the capital of Colombia, with a set of 20 surrounding municipalities, located mainly in the department of Cundinamarca. This integration seeks to consolidate a functional, balanced and sustainable urban system, capable of facing the challenges of population growth, pressure on public services, regional mobility and joint planning of the territory. The City-Region is conceived as a space for inter-municipal cooperation, where mass transport infrastructure, shared environmental management, complementary economic development and social cohesion are promoted, recognizing the interdependencies between Bogotá and its neighboring municipalities. Although the list may vary depending on the technical or political approach, the municipalities commonly included are: Soacha, Chía, Cota, Funza, Mosquera, Madrid, Cajicá, Zipaquirá, Tocancipá, La Calera, Sibaté, Tenjo, Tabio, Facatativá, El Rosal, Bojacá, Zipacón, Subachoque, Gachancipá and Sopó.

The outstanding thing is the achievement of integrated planning of urban and rural growth. Optimize mobility through mass transportation systems such as commuter trains, cables, and articulated buses. Reduce territorial inequality between Bogotá and its neighboring municipalities. Preserve strategic ecosystems such as the Bogotá Savannah and its water sources. Promote regional economic development with a focus on innovation, agribusiness, and services. Bogotá stands out as the most complex, dynamic, and strategic city region in Colombia, but it also faces unique challenges compared to other cities and regions of the country. Below is a key comparison in Table 1:

Table 1:Bogota vs. other Cities Region in Colombia

City Region	Key features	Key Challenges
Bogotá-Cundinamarca	Political, economic and population epicenter of the country. High urban density. Network of satellite municipalities.	Road congestion, institutional fragmentation, disorderly growth.
Medellín-Valle de Aburrá	Metropolitan integration model with the Metropolitan Area of the Aburrá Valley. Good transport system (Metro,	Urban expansion in risk areas, pressure on public services.

	Metrocable).	
Cali-Yumbo-Jamundí	Industrial and logistics node in the southwest. Connection with the Pacific. Growth in peripheries.	Weak regional articulation, insecurity, deficit in mass transport.
Barranquilla-Soledad	Strong urban integration. Port and commercial development. Advances in road infrastructure.	Climate vulnerability, urban informality, pressure on the Magdalena River.
Bucaramanga-Girón-Piedecuesta-Floridablanca	High quality of life. Good management of public services. Orderly growth.	Limitations in regional connectivity and mass transportation.

Note. What makes Bogotá unique as a city-region? Population scale: More than 10 million inhabitants in its functional area. Territorial diversity: From rural areas of Sabana to dense urban centers. Regional inequality: Municipalities such as Soacha are growing rapidly without proportional infrastructure. Integration potential: Projects such as the Regiotram and the Commuter Train seek to articulate the region.

It can be seen in figure 1, articulated TransMilenio that are distinguished by their red and yellow colors, the size is greater than all other vehicles, it is noteworthy that in this section of the northern highway with Calle 100, there are several routes to go from the south to the north and to the center of Bogotá. The service stations have already been in use for years, but they continue to provide protection, orientation and collection center of a primary multimodal transport system. In the image, there is a traffic jam in the north-south direction, while there is solvency and fluid maneuverability in the south-north direction. Users in private vehicles and motorcycles are affected because the space is reduced compared to that of the Transmilenio for exclusive use. In such busy sectors, pedestrian bridges have been built, which give way to people who are going to use public transport services. Similarly, the contrast of mobility and transportation is reflected in the panorama left by the buildings, where road users converge and maintain.

Figure 1:Advances in multimodal systems in transport



Note. This image was taken on Carrera 19 with Calle 98 north of Bogotá, on May 31, 2025 at 10:45 a.m.

User reviews confirm that, despite congestion and high demand, TransMilenio is perceived as the fastest and most agile means of transport in the sector, and that it reduces travel times. This is achieved precisely thanks to its exclusive lane, which allows it to avoid the traffic jam that does affect private vehicles. In other words, although it is "stressful and exhausting" due to overcrowding, the main benefit is the speed and the greater probability of arriving on time. This point of tension (prioritization of mass transport over the particular) is a central aspect of mobility in Bogotá. Opinions confirm that the system is always congested (inside buses and stations), especially at "rush hour" On a general level, the system is facing a multidimensional crisis (financial, technical, sociocultural), and one of the main complaints is the quality of service and the congestion that is generated, since the high demand exceeds the capacity of the fleet, which translates into full buses and long waiting lines for users, even despite having the exclusive lane.

The station in that section is known as Calle 100 – Marketmedios. TransMilenio stations, although central for access to the system, face problems of condition and quality. In addition, security in these areas, both for users and employees, is a point of constant concern, linked to overcrowding and other phenomena such as evasion (colados). Visual observations of the North Highway with Calle 100 perfectly capture the tension between coverage and quality. On the one hand, TransMilenio allows rapid travel for thousands of people thanks to its infrastructure (exclusive lane and stations), but, on the other hand, that same priority translates into severe congestion for private traffic and an uncomfortable and overcrowded service experience for its own users.

5. DISCUSSION: CHALLENGES AND OPPORTUNITIES IN URBAN MOBILITY IN THE CITY REGION.

Mobility in city-regions such as Bogotá and its surrounding municipalities faces a growing complexity, marked by chaos in transport, disorderly urban sprawl, and the lack of articulation between actors. To address these challenges, it is essential to promote scientific support in road infrastructure, which allows decisions to be made based on data, simulations, and territorial impact studies. One of the critical points is the culture of mobility on motorcycles, which has grown exponentially. Although it represents a quick solution for many citizens, it has also generated tensions in road safety, especially in areas with constant traffic of bicycles and pedestrians. This requires a road dissemination strategy that promotes mutual respect between road actors and encourages responsible behaviors.

Collaboration in urban planning between local governments, universities and citizens is key to designing megaproject models that not only respond to transport needs, but also integrate criteria of sustainability, equity and resilience. Examples such as the Bogotá metro or aerial cables in peripheral areas show how a metropolitan vision can transform mobility. However, difficulties in mobility persist due to lack of maintenance in the existing infrastructure. The maintenance of cycle lanes and routes is essential to guarantee the safety of non-motorized users, especially in contexts where the use of bicycles has become a viable and ecological alternative.

At the same time, crime control in transport must be strengthened through technology,

community surveillance and institutional presence. Immediate road service posts can function as rapid response nodes to accidents, congestion or situations of insecurity, improving citizen perception and the efficiency of the system. Finally, thinking about mobility from a city-region perspective implies overcoming administrative borders and planning in an integrated manner. This requires political will, technical innovation and active citizen participation to build a fairer, safer and more efficient transport system.

5.1 Chaos in Bogotá's transport and mobility.

By conducting an exhaustive review of the historical, technical, and social background related to the chaos in the urban transport system and its limited regional connection. This review should include the analysis of previous studies, institutional diagnoses, mobility plans, and national and international experiences that show the factors that have contributed to the disorder in the mobility of the main cities and their metropolitan environment. The objective is to identify common patterns, structural causes, and territorial dynamics that have hindered the development of an efficient and integrated transport network. From this base, it seeks to generate inputs for the proposal of viable solutions in terms of road infrastructure, which respond to the accelerated growth of capital cities and promote functional articulation with neighboring cities, under criteria of sustainability, territorial equity, and operational efficiency.

In Figure 2, Daniel Páez (2019) analyzes: "Mobility in Bogotá: it leaves the most serious problem in the capital, but it is also very difficult to solve. What does it leave and, above all, what would it do if it had a little imagination?" (p. 3). The reflection on mobility in Bogotá strikes a very sensitive and urgent chord: transport in the capital is not only a technical problem, but also a social, political and cultural one. His statement that it is "the most serious problem" is not exaggerated. Mobility directly affects the quality of life, productivity, equity and even the mental health of citizens. But the most provocative part of his analysis is in the invitation to use "a little imagination". What does he leave us? He leaves behind a fragmented city, where time lost in traffic jams and eternal journeys becomes a form of inequality. He leaves behind a frustrated but also resilient citizenry that has learned to overcome obstacles with creativity.

It leaves an opportunity: that of rethinking the city from the collective desire to move better, faster and with dignity. What if I had imagination? Imagination is not fantasy: it is thinking beyond the obvious. What if schools and universities adjusted their schedules to decongest rush hours? What if the use of electric bicycles were encouraged with real subsidies and integrated insurance? What if neighborhoods were designed so that work, study and leisure were closer, reducing the need to travel? What if mobility data were used to co-create solutions with citizens, not just to feed technical diagnoses? Páez's phrase is a call to break inertia. Solving mobility in Bogotá will not be easy, but it will not be impossible either if rigorous planning is combined with collective imagination.

Figure 2: Congested roads for private vehicles and free for Transmilenio.



Note. Adapted from Razón Pública [Photo], by Daniel Páez, Flickr (https://razonpublica.com/semana-del-24-de-junio-de-2019/). CC BY-SA-NC

A structural problem that transcends the merely road is evident: the closure of the Vía al Llano not only affects connectivity between Bogotá and Villavicencio, but also reveals the fragility of the transport system in the face of disruptive events. From a discussion perspective, it is pertinent to question the institutional response capacity to this type of crisis, as well as territorial planning that depends excessively on a single strategic corridor. In addition, the impact on public transport and urban mobility suggests broader economic and social consequences: delays in the logistics chain, impact on tourism, loss of productivity and deterioration of the quality of life of citizens. This type of event should promote the design of resilient mobility policies, with alternative routes, multimodal systems and contingency protocols. In the context of your doctoral research, this case can serve as an example of how strategic decisions in infrastructure and organizational leadership must anticipate risks and guarantee operational continuity

The reinforcement of alternate routes and internal detours in Bogotá, together with the redirection of traffic to varied corridors and the priority maintenance of these with millionaire investments in critical points, have diversified and improved the resilience of the national and regional road network. The agile adjustment of local routes internal to Bogotá, modification of routes of the Integrated Public Transport System (SITP), due to metro works or road closures, detour planning, flow monitoring; shows the technical maturity of the district administration and its alignment with the national strategy.

The closure of the Vía al Llano since September 29, 2025 has had a notable impact on mobility in Bogotá and its surroundings, mainly after the blockades on several crucial sections of the highway that links with Villavicencio. This situation led to the preventive closure of different points between kilometers 0 and 82 and has disrupted public transport routes. (Pulzo, 2025, p. 5).

According to the authors Valle, Aguilar and Velasco (2022) it is a problem that is still unsolved which prevents the sustained growth of cities, the existing vehicular chaos shows that the solution is very far from this problem, they go hand in hand with the economic losses caused by the delay in arrival times and the delivery of raw materials in the logistics chain to producing companies as well as services in general (p. 787).

In the same way, it contributes to making visible the direct relationship between urban

mobility and economic development, which is key to guiding public policies and planning strategies. By pointing out that vehicular chaos not only affects the quality of life of citizens, but also the efficiency of the production and service chain, the authors highlight the urgency of comprehensive solutions. This type of analysis opens the door to constructive debates on innovation in transport, investment in infrastructure and promotion of sustainable alternatives that allow progress towards more balanced and competitive urban growth.

A critical and current problem in many Latin American cities is raised: vehicular chaos as a structural obstacle to urban and economic development. The commentary can be approached from three key angles: it highlights how disorder in urban transport not only affects daily mobility, but also has profound implications on the economy and business logistics. By stating that it is a problem "still unsolved", the authors underline the persistence of this phenomenon, suggesting a failure in urban planning, investment in infrastructure and the articulation of public policies. In addition, the focus they establish between vehicular chaos and economic losses is especially relevant: delays in the delivery of raw materials and products directly affect the efficiency of supply chains, raise operating costs and reduce the competitiveness of companies. It connects transport with productivity, which makes it a strategic issue for business management and policymaking.

It is right to pose a structural challenge for sustainable urban development. The claim that cities will continue to concentrate the majority of the world's population is not only supported by global demographic data, but also forces us to rethink how urban environments are designed, managed and adapted in the face of this constant pressure. The concept of "complex spaces" is key: cities are not just physical agglomerations, but dynamic systems where infrastructure, services, mobility, economy, culture and governance converge. The warning against them becoming "chaotic environments" underscores the need for strategic planning, technological innovation and adaptive leadership to ensure quality of life, operational efficiency and urban resilience. It is possible to explore how strategic leadership manages to contribute to avoiding this "urban chaos" through collaborative governance models, intelligent transport management, and data-based territorial planning.

The sustained growth of the urban population turns cities into scenarios of great complexity, where planning and management are decisive to avoid chaos. This approach is valuable because it not only describes a demographic trend, but also invites reflection on the responsibility of governments and society in general to design more resilient, sustainable and equitable urban environments. By recognizing that population growth is inevitable, it opens the door to thinking about innovative solutions: from the optimization of public transport and green infrastructure, to the incorporation of smart technologies that allow better management of resources. In this sense, the argument is not limited to pointing out a problem, but also suggests the urgency of transforming urban complexity into an opportunity to build more livable and orderly cities.

Cities are home to the majority of the world's population and this number is not expected to stop increasing. This turns urban environments into complex spaces that would have to house these people without the city becoming a chaotic environment. (Quella, 2023, p. 9).

5.2 Difficulties in mobility and transport

Figure 3 shows how the accelerated growth of cities, especially in contexts such as Bogotá

and its metropolitan region, has generated a series of structural tensions in mobility and mass transport systems. This phenomenon, driven by demographic concentration, disorderly urban sprawl, and the lack of intermunicipal planning, has overwhelmed the installed capacity of existing infrastructures, generating a scenario of chronic congestion, operational inefficiency, and inequality in access to transportation. Among the main difficulties identified is the saturation of the main road corridors, where the volume of vehicles far exceeds the capacity of the roads, causing excessive travel times, increased pollution levels, and deterioration of the quality of urban life. Added to this is the fragmentation of the public transport system, characterized by weak integration between modes (buses, TransMilenio, bicycles, taxis, motorcycles), which prevents fluid and multimodal mobility. In many outlying areas, access to mass transit is limited or non-existent, forcing citizens to rely on informal solutions or to make long and expensive journeys.

Another critical factor is the lack of maintenance and modernization of road infrastructure. Many roads have advanced deterioration, lack of adequate signage, poor lighting, and unsafe conditions for pedestrians and cyclists. This situation not only increases the risk of accidents, but also discourages the use of sustainable means of transportation. The culture of mobility on motorcycles, for example, has grown in response to the inefficiency of the system, but it has brought with it an increase in accident rates and road conflicts. Likewise, mobility in the city-region is affected by the poor articulation between the transport policies of the different municipalities. The absence of a shared metropolitan vision has made it difficult to implement integrated solutions, such as intermunicipal transport networks, unified fare systems, or regional mobility plans. This lack of coordination translates into duplication of efforts, fragmented investments, and an uneven user experience, especially for those who must commute daily between municipalities for work, education, or health reasons.

In this context, the proposal of models for mass transport megaprojects is presented as a strategic alternative to face these difficulties. These models should not only focus on the construction of new infrastructure, but also on the transformation of the mobility system from a systemic, sustainable and people-centered perspective. Planning is required that contemplates the expansion of mass transport networks with regional coverage, the implementation of efficient intermodal nodes, and the incorporation of smart technologies for traffic management and road safety. In addition, it is essential that these megaprojects are designed with criteria of territorial equity, ensuring that the benefits of public investment reach the most vulnerable and disconnected areas. Citizen participation, the gender approach and the inclusion of diverse populations must be guiding principles in the formulation of these solutions. Only in this way will it be possible to move towards a mobility model that not only solves current problems, but also anticipates the future needs of a city-region in constant transformation.

Figure 3: Mobility complications



Note. This image was recorded on 100th Street with the North Highway of Bogotá, on August 14 at 10:00 a.m.

In Latin America, Lima and Bogotá stand out for the deterioration and danger of their urban transit conditions. The supply of public transport, the main mode of travel for the popular classes, is very different in the two cities, but it is the subject of much criticism in both. Likewise, urban transport is the first reason for dissatisfaction in public opinion, after insecurity, according to the Bogotá and Lima Cómo Vamos opinion polls. The problem is exacerbated in the popular peripheries, where commutes to work or study are more difficult and extensive. The transport reforms implemented in both cities do not seem sufficient given the magnitude of the problem and many citizens continue to suffer from a low quality of service. (Robert Jérémy et al, 2022, p. 3).

The quote from several authors invites an in-depth reflection on how gender-based violence not only affects women's personal safety, but also their right to mobility and equitable use of the city. By speaking of a "differentiated socio-spatial approach", the authors underline that women's experience on public transport is not homogeneous, but is marked by conditions of time, space and perception of risk. This means that gender-based violence is not limited to an isolated event, but reconfigures urban dynamics: it determines which routes are chosen, at what times people travel and even what job or educational opportunities can be taken advantage of.

Reflecting on this approach implies recognizing that urban mobility is also a matter of social justice. Ensuring that women can occupy public transport in conditions of equality and safety not only improves their quality of life, but also strengthens social cohesion and the productivity of the city as a whole. In this sense, the text opens the door to thinking about public policies that integrate the gender perspective in the design of transport, from infrastructure to staff training and the implementation of protocols for the prevention and care of violence, "occupation of women in public transport units in the Monterrey

Metropolitan Area with a socio-spatial approach differentiated by the effect of gender violence." (Ferniza & Soto, 2021, p. 3).

González and Czytajlo (2022) indicate that urban planning with a gender perspective is necessary to promote equity and give rise to women's participation in decision-making processes. Urban planning practice also intervenes on people's accessibility to make use of the goods and services provided by the city. The possibilities of access are unequal between women and men, while their needs and desires are different. (p. 13).

For example, in the urban planning model with a gender perspective, "Case: Design of an inclusive public transport system in a Latin American city", a citizen committee is formed where women represent at least 50% of the members. This committee participates in the definition of routes, schedules and transport safety conditions. Safe and illuminated stops are implemented, with alert buttons and surveillance cameras, responding to women's concern about gender violence in public space. Ramps and universal accesses are designed, thinking of women with baby strollers, the elderly and people with reduced mobility.

Similarly, extended hours are established on routes that connect residential areas with work and study centers, considering that many women combine work journeys with care responsibilities. Designated spaces are set up for women and children during peak hours, as a preventive measure against harassment. Greater confidence and safety in the use of public transport. Increased participation of women in economic, educational and cultural activities. Reduction of inequalities in access to urban goods and services. This model shows how urban planning with a gender perspective is not limited to theory, but translates into concrete actions that improve equity and the quality of urban life.

5.3 Models of transport megaprojects

The construction of urban megaprojects, seen as urban interventions with a mix of land uses, construction of residential areas, facilities and infrastructure that improve the accessibility and interest of the real estate market with the collaboration of the public sector, have become increasingly common, especially in large cities, but for the public sector to be in charge of the construction of a new city, as was done in the middle of the last century with Brasilia or Chandigarh, is no longer so common. (Espinosa, Flores, & Guevara, 2024, p. 1).

In the case of Bogotá, the construction of urban megaprojects has also become a frequent practice, understood as interventions that combine different land uses, the construction of residential areas, the incorporation of facilities and the creation of infrastructure aimed at improving accessibility and boosting the real estate market, generally with the collaboration of the public and private sectors. Examples of this are projects such as "Ciudad Salitre, Lagos de Torca or the Partial Plan for the Renovation of the Expanded Center", which seek to integrate housing, commerce, services and transport in the same environment.

However, as in other large cities, it is uncommon for the public sector to take on the construction of a "new city" from scratch on its own, as happened in the last century with emblematic experiences such as Brasilia or Chandigarh. In Bogotá, rather, the trend has been to "reconfigure and densify existing areas", betting on urban renewal and planned expansion in the periphery, which reflects a more fragmented growth model dependent on

public-private articulation.

The construction of urban megaprojects has established itself as a recurrent intervention strategy, characterised by the mix of land uses, the construction of residential areas, the incorporation of collective facilities and the development of infrastructure aimed at improving accessibility and boosting the real estate market. "they are connected to global economic and service networks, subject to alien interests while having little connectivity at the local level, and they are unaware of/unaware of the needs and traditions of the societies that inhabit these territories" (Dembicz & Roux, 2025, p. 310).

For the authors Alberti et al (2022), the Medellín Metro is the result of a long planning process carried out in the city of Medellín – located in the Aburrá Valley, in the department of Antioquia, in Colombia. The selection of the route for the development of a mass transit system began in 1950, however, it was only in 1977 that a concrete project for the construction of a metropolitan train emerged. (p. 9). In the case of Bogotá, the Metro has also been the result of an extensive and complex planning process, marked by multiple attempts and rethinking over several decades. Since the mid-twentieth century, proposals to provide the capital with a mass transport system on rails began to emerge, although the initial projects failed to materialize due to political, technical, and financial factors.

It was only until 2019 that a concrete project was consolidated with the award of the first line of the Bogotá Metro, conceived as an elevated metropolitan train that will run through the city from southwest to northeast. This process reflects, as in Medellín, the persistence of the need for a railway system in the capital, but also evidences the particularities of Bogotá: a city with a larger population, more complex mobility challenges and a historical dependence on road transport systems such as the TransMilenio. Unlike Medellín, the projects were delayed by political, technical and financial factors.

5.4 Collaboration in urban planning of the city-region

The strategic intersection between technology and citizenship that is key to transforming urban mobility in intermediary cities in Latin America. In this context, data science not only provides analytical tools to understand patterns of displacement, congestion or accessibility, but also allows us to visualize territorial inequalities and anticipate more equitable planning scenarios. Its application goes beyond technical diagnosis: when it is linked to citizen participation processes, it becomes a catalyst for more inclusive and contextualized decisions. Intermediary cities, often marginalized compared to large metropolises, face particular challenges: accelerated growth, limited infrastructure and connectivity gaps.

In them, the active participation of the community through surveys, collaborative mapping, digital platforms or local assemblies, allows the data collected to reflect not only what happens, but what matters to those who live it. Thus, sustainable mobility is promoted that is not defined only by environmental or technical criteria, but by its ability to respond to the real needs of the inhabitants. This dual technological and participatory approach represents an opportunity to democratize urban planning, recognizing that sustainability is not achieved only with electric buses or bike lanes, but with processes that integrate local knowledge, institutional transparency and citizen co-responsibility, as indicated in "the role of data science and citizen participation in the promotion of sustainable urban mobility in intermediary cities in Latin America." (Ramírez, Ruiz & Gómez, 2025, p. 1).

The author Zúñiga (2025) states that the crucial policy related to mobility and urban planning in medium-sized cities such as Loja, Ecuador. The research focuses on the multiple challenges inherent in the agenda-setting, added to institutional weakness and the lack of integration of mobility policies and urban planning, which have affected the implementation of sustainable and coherent strategies. Despite existing regulations, the city faces deficiencies in the coordination and execution of these policies, which underscores the importance of an integrated approach. (p. 1).

Loja, like many intermediary cities in Latin America, represents an urban laboratory where the tensions between technical planning and political governance are evident. Zúñiga's (2025) research reveals that, beyond having formal regulations, institutional fragmentation and the lack of articulation between local, regional, and national actors hinder the implementation of sustainable strategies. This disconnection translates into mobility plans that do not dialogue with territorial planning, nor with the real needs of citizens. The implementation of sustainable urban mobility is not only a technical issue, but also a deeply political one: it involves deciding which problems are prioritized, which voices are heard, and which city models are promoted. In contexts such as Loja's, where institutional capacities are limited and resources are scarce, the absence of an integrated vision generates isolated, often reactive, and unsustainable policies.

In addition, the lack of effective citizen participation mechanisms weakens the legitimacy of the decisions made. Without spaces for co-creation, plans tend to reproduce centralized logics that do not capture local dynamics or daily mobility practices. An integrated approach, as the author suggests, not only requires inter-institutional coordination, but also an openness to participatory processes that recognize territorial knowledge and promote co-responsibility. In short, the case of Loja shows that urban sustainability does not depend only on having good policies, but on having governance structures capable of articulating, executing and adapting them with citizens as the protagonist.

Torrent's (2021) observation about the loss of the articulating role of architecture and urbanism in Chilean cities is echoed in Bogotá, where there is also a disconnection between major urban decisions; master plans, megaprojects, renovation regulations, and the daily experience of those who inhabit the city. In many cases, urban design responds more to market logics, technical efficiency, or institutional image than to the social, cultural, and affective practices that shape public space. In Bogotá, this tension manifests itself on several fronts: Spatial fragmentation: Popular neighborhoods and urban peripheries grow with little presence of architectural design or sensitive planning, which generates environments that are uninhabitable, unsafe, or exclusionary. Disarticulation between scales: The broad definitions of the POT (Territorial Planning Plan) or infrastructure projects such as the Metro or the Regiotram do not always dialogue with neighborhood microscales, where mobility, informal commerce, and community life have their own dynamics.

Deficit of participation in urban design: Although there are consultation mechanisms, architecture and urbanism are still perceived as technical disciplines, far from citizens. This limits their ability to translate collective aspirations into meaningful spatial forms. Aesthetics without belonging: Some renovated public spaces, squares, parks, green corridors, privilege a homogeneous and "modern" aesthetic that does not always reflect the cultural diversity or

urban memories of the territories. In this sense, Bogotá faces the challenge of repoliticizing urban design, recognizing that architecture and urbanism are not only technical tools, but languages that can (and should) mediate between structural decisions and citizen experience. Recovering this articulating role implies opening co-design processes, strengthening urban pedagogy, and linking technical knowledge with territorial knowledge.

A review of the recent situation of Chilean cities. verifies that architecture and urbanism have lost at least part of their articulating roles between the great definitions that concern the urban phenomenon and the experience that citizens can have in the space of the city. (Torrent, 2021, p. 19).

5.5 Scientific support in road infrastructure

Table 1 analyzes entities specializing in mobility and transportation. Manage scientific support with universities specializing in infrastructure and transportation. The statement by Ávalos, Palomino, and Muñoz (2025) underscores a key principle in contemporary road engineering: infrastructure design should not be limited to the basic functionality of transportation, but should actively integrate safety, sustainability, and technological innovation criteria. Preventive measures in road design. Incorporating preventive measures involves anticipating the factors that generate road accidents. This includes: Safe geometric design: curves, slopes, intersections, and signage should minimize conflict points and facilitate visibility. Flow separation: dedicated lanes for bicycles, pedestrians, and public transportation reduce dangerous interaction between modes.

Speed management: use of elements such as roundabouts, speed bumps and smart signage to control critical speeds. Lighting and visibility: reflective materials, LED luminaires and presence sensors improve night-time perception. Innovative materials. The choice of materials directly influences the durability and safety of the road: Polymer-modified asphalts that offer greater wear resistance and better grip in wet conditions. Photocatalytic pavements that reduce pollutants and improve air quality. Draining surfaces that prevent water accumulation and reduce the risk of hydroplaning.

Advanced technologies. The use of technologies allows for a smarter and more reactive infrastructure: Sensors integrated into the pavement to monitor vehicle load, temperature, and wear. Real-time traffic management systems, connected to data networks that optimize flow and alert on incidents. Connected infrastructure for autonomous vehicles, including digital signage and V2I (vehicle-to-infrastructure) communication. Together, these strategies not only reduce the risk of accidents, but also extend the useful life of roads, optimize public resources, and align road development with international standards for safe and sustainable mobility. "The design of road infrastructure must incorporate preventive measures that reduce the risk of traffic accidents, prioritizing the use of innovative materials and advanced technologies." (Avalos, Palomino, & Muñoz, 2025, p. 201).

Table 2: Entities specialized in mobility and transport

Activity	Description	Responsible	Target Universities	Estimated Date	Indicators of success
Identification of specialized universities	Mapping of institutions with programs	Project Technical Team	National University, Uniandes,	10–15 Oct 2026	Validated list of at least 5 universities

	in road engineering and transportation		University of Cauca		
Institutional contact	Sending letters of intent and request for collaboration	Alliances Coordinator	According to validated list	16–20 Oct 2026	Number of positive responses received
Outreach meetings	Schedule and hold meetings to present the project	Project management	Universities with confirmed interest	Oct 21–31, 2026	Signed meeting minutes with preliminary commitments
Definition of scientific support lines	Establish collaboration themes: road design, sustainable mobility, innovation	Technical-scientific committee	Allied universities	01–05 Nov 2026	Technical Collaboration Framework Document
Formalization of agreements	Drafting and signing of scientific cooperation agreements	Legal and General Management	Selected Universities	06–15 Nov 2026	Number of agreements signed
Initiation of joint activities	Development of studies, consultancies and knowledge transfer	Joint technical teams	Allied universities	From 16 Nov 2026	Technical reports delivered, participation in events

Note. This table allows the management of scientific support to be structured in a clear way, with verifiable goals and defined times.

The analysis of urban and metropolitan evolution in Mexico over the last four decades, as proposed by Sobrino and Ugalde (2019), offers a comprehensive look at the processes of territorial transformation that have marked the future of Mexican cities. The breadth of dimensions addressed, from territorial configuration to conflicts over infrastructure, reveals that the urban phenomenon cannot be understood only from physical growth, but as a deeply complex political, social, and legal framework. One of the key contributions of the text is to make visible the transition from the rural to the urban world as a process that not only reconfigures space, but also social relations, forms of governance, and distributive tensions. In this sense, the emergence of the metropolitan phenomenon has not been accompanied by robust institutional coordination or sufficiently adapted legal frameworks, which has generated gaps in the management of the territory and in the provision of basic services.

Problems such as irregular land tenure, housing deficit or conflicts arising from large infrastructure works are not merely technical: they are symptoms of planning that has historically been fragmented, exclusive and not very participatory. In addition, the text underlines the role of knowledge in urban evolution, which invites us to rethink the role of academia, local knowledge and the production of data as inputs for fairer and more contextualized planning. This approach is especially relevant for other Latin American cities such as Bogotá, Medellín or Quito that face similar challenges: accelerated growth, territorial inequality, and an urgent need to articulate urban policies with processes of social inclusion and citizen participation.

The urban and metropolitan evolution in contemporary Mexico through the analysis of its urbanization in the last forty years: the territorial configuration of urban localities; the emergence and dynamics of the metropolitan phenomenon; the coordination and legal framework of urban and metropolitan development; the transition from the rural to the urban world, and some of the numerous problems that afflict Mexican cities, such as the regularization of land tenure, access to housing, poverty, conflicts over the realization of large infrastructure works and the role of knowledge in the evolution of cities. (Sobrino & Ugalde, 2019, p. 2).

Access to road infrastructure has a low direct relationship with the well-being of the population in the province of Atalaya 2024, since the Rho Spearman coefficient is 0.210** and the Sig. value < 0.01. This finding determines that the lower the perception of access to road infrastructure, the lower the perception of well-being of the population. Therefore, effective road management can guarantee a quality service, which highlights raising awareness among the population exclusively in rural areas about the importance of a road network that in the long run brings development and progress generating well-being for all Peruvians. (Joaquín, 2025, p. 93).

The author presents a relevant statistical finding: although Spearman's correlation coefficient (Rho = 0.210) indicates a direct but weak relationship between access to road infrastructure and the perception of well-being in the province of Atalaya, the significance value (< 0.01) confirms that this relationship is statistically significant. This suggests that, although the link is not strong, there is a consistent connection between how people perceive their road access and how they value their quality of life. This result has important implications: Perception as a key indicator; The study does not only measure physical access to roads, but also the perception of that access, which introduces a subjective dimension that reflects how people experience infrastructure in their daily lives. This is crucial in rural areas, where the quality, frequency of maintenance, and connectivity of roads can vary widely.

Road management as a welfare policy: Although the correlation is low, the author stresses that effective road management that guarantees quality, continuity and territorial relevance can improve citizen perception and, with it, contribute to well-being. This implies that infrastructure should not be thought of only as a physical work, but as part of a human development strategy. Rural and territorial approach: The call to raise awareness among the rural population about the importance of the road network reveals a frequent tension in Latin America: infrastructure is often planned from urban centers, without sufficient dialogue with rural communities. Investing in rural road networks not only improves mobility, but also strengthens access to services, markets, education and health, generating

more equitable conditions. The role of knowledge and awareness: The text also points to the need to educate and sensitize about the strategic value of road infrastructure. This can be translated into participatory processes, community campaigns or co-management models that link citizens with the maintenance and use of roads

5.6 Preventive Road dissemination strategy

The relevance of traffic campaigns to improve road safety is highlighted, but they provide nuances about their effectiveness and citizen perception according to the local context. Faus (2024): Social marketing and citizen perception. It states that traffic campaigns contribute to improving road safety. It highlights a positive citizen perception of traffic advertisements, identifying variables that influence this perception (such as clarity of the message, emotional tone, repetition, and cultural adequacy). It detects deficits in the marketing strategies used, proposing recommendations to improve the design and evaluation of future campaigns. The effectiveness of a specific campaign in Bogotá, focused on drivers and pedestrians, is analyzed. It finds that citizen perception varies according to the type of message and channel used, with direct and visual communication in public spaces being more effective. It is suggested that social marketing should be adapted to local urban behavior, and that citizen participation improves the reception of the message.

The relevance of traffic campaigns as a measure that contributes to the improvement of road safety. In addition, a positive citizen perception of the effectiveness of traffic advertisements is manifested, identifying the variables that contribute to increasing this social perception. The findings of the research allow us to identify deficits in the marketing strategies used in traffic, mobility and road safety, and consequently, to develop proposals and recommendations for the development and evaluation of future campaigns in this area. (Faus, 2024, p. 2).

Various studies support and expand on the argument of Tinoco, Solís, and Neira (2025), by demonstrating that the combination of technical inspections and road safety education not only reduces accidents, but also improves citizen culture and co-responsibility in public space. Vehicle technical inspection: more than a procedure. A preventive model is proposed for Bogotá that includes technical inspections as part of a comprehensive road safety strategy. It points out that the early detection of mechanical failures avoids serious incidents, especially in areas with high pedestrian accidents. Periodic inspections make it possible to identify problems in brakes, lights, tires, and emissions, which reduces the risk of accidents due to technical failures, especially in public transport vehicles and cargo. Road safety education: training for co-responsibility.

The implementation of a comprehensive system that combines periodic vehicle inspections and road safety education significantly reduces accidents. Ensuring that vehicles comply with technical safety standards minimizes mechanical failures on the road, while road safety education encourages more responsible and safer driving. (Tinoco, Solís, & Neira, 2025, p. 1603).

The authors Avalos, Palomino, and Muñoz (2025) indicate that the design of road infrastructure should incorporate preventive measures that reduce the risk of traffic accidents, prioritizing the use of innovative materials and advanced technologies. The implementation of optimized asphalt mixtures and permeable pavements improves vehicular

adherence and mitigates the negative effects of water on the road, which contributes to stability and safety in driving. Likewise, the stabilization of soils with high-resistance materials prolongs the useful life of the infrastructure and prevents structural failures that could generate accidents. (pp. 201-202).

The authors' approach proposes that road design should not only respond to mobility needs, but also anticipate risks through technical solutions. This implies a transition from reactive models to proactive planning, where each component from the pavement to the base of the soil fulfills a preventive function. Safety from the surface, optimized asphalt mixtures, such as those modified with polymers or recycled rubber, improve adhesion and wear resistance, which reduces the risk of skidding and failures in adverse weather conditions. Permeable pavements, in addition to mitigating the effect of accumulated water, contribute to urban sustainability, reducing flooding and improving the visibility of the road in rain. Structural prevention, stabilization with geopolymers, synthetic fibers or hydraulic lime, allows the lower layers of the road to better withstand dynamic loads, avoiding deformations that could cause accidents. This technique prolongs the useful life of the infrastructure, reducing maintenance costs and increasing the reliability of the road system.

5.7 Immediate Road service posts

According to Fernández and Luna (2025), the lives of people who are involved in traffic accidents depend to a large extent on the timely attention of trained personnel who can come at first, especially when the impact of the vehicle is strong; it must be understood that the emergency unit needs to expedite the conditions to evaluate the events and decide what needs to be prioritized to improve the survival percentage of people affected by a traffic accident. (p. 14).

The authors' approach underscores a critical and often invisible truth in road safety debates: the immediate and specialized response to a traffic accident can make the difference between life and death. In contexts where the impact is severe, as they mention, the ability of emergency teams to assess, prioritize and act quickly becomes a determining factor of survival. This approach not only highlights the need for continuous training of pre-hospital care personnel, but also for institutional infrastructure that allows a coordinated reaction: efficient communication systems, clear protocols, availability of resources and safe access routes.

In many regions of Latin America, including rural or peripheral areas of cities such as Bogotá or Ibagué; these conditions are still precarious, which amplifies the vulnerability of victims. In addition, the text invites us to rethink the role of emergency units as strategic nodes within the urban mobility system. It is not enough to have ambulances or hospitals; integrated management is required that articulates health, transport, technology and citizenship. This includes everything from georeferencing of critical points to community road safety education.

Improve institutional capacity to respond effectively to road accidents or emergencies, through continuous training of personnel and the active inclusion of employees in the review and improvement of the Strategic Road Safety Plan (PESV). Design of training modules on first aid, crisis management, communication in emergencies and use of immediate attention protocols. Periodic drills; in real or virtual scenarios to evaluate

reaction times and coordination between areas. Internal certification for key personnel in road emergency response, updated annually. Biannual surveys of employees to identify risks, operational failures or critical areas in their routes or functions. Participatory review tables of the PESV, where proposals for improvement are analyzed from the daily experience of the personnel.

Digital channel of suggestions so that any employee can report incidents, propose adjustments or share good practices. Performance indicators to evaluate the effectiveness of the emergency response (attention time, coordination, satisfaction). Annual report on the review of the PESV, with contributions from employees, survey results and adjustments implemented. Institutional recognition of teams or individuals who actively contribute to the improvement of the PESV and road safety. Greater efficiency in the attention to accidents and reduction of risks in unforeseen situations. Strengthening of the collective commitment to road safety. Improvement of the PESV as a living tool, adapted to operational and territorial realities.

Improve response procedures for accidents or emergencies, ensuring that personnel are trained to act quickly and reduce risks in unforeseen situations. Including employees in the review and improvement of the Strategic Road Safety Plan (PESV) through regular meetings or surveys allows them to identify problems that they themselves detect in their daily work and generates a sense of shared commitment. (Concha, 2025, p. 77).

Traffic accidents define a pandemic with real war figures. Every day, 4,000 people die on the world's roads, five of them in Spain. For each of these fatalities, it is estimated that there are four injured with injuries that cause permanent disability, such as damage to the brain or spinal cord, ten serious injuries and forty minor injuries, data that are growing brutally in low- and middle-income countries, where less than half of the world's vehicles account for 90% of the fatalities in traffic accidents. (Fernández, 2024, p. 15).

The statement that traffic accidents constitute a "pandemic with war figures" is not a rhetorical exaggeration, but a forceful denunciation of a global crisis that has been normalized. Fernández starkly makes visible the human impact of road accidents, not only in terms of deaths, but also of permanent injuries that radically transform the lives of thousands of people every day. The use of comparative data – such as the 4,000 deaths per day and the 90% of victims concentrated in low- and middle-income countries – reveals a structural inequality that runs through the road phenomenon. This approach allows us to identify at least three critical dimensions: territorial and economic inequality; The concentration of victims in countries with fewer vehicles shows that the problem is not only one of quantity, but also of the quality of infrastructure, regulation and post-accident care. In contexts such as Latin America, where many rural roads are poorly signposted, poorly maintained and without quick access to emergency services, the risk is multiplied.

Coupled with the above, the invisible impact of disability: By pointing out that for every death there are four people with permanent injuries, the author forces us to look beyond the count of fatalities. Disabilities derived from road accidents generate social, family, and economic costs that are rarely included in mobility analyses. This requires comprehensive policies that link health, inclusion, and rehabilitation. Urgency of an intersectoral public policy; The magnitude of the problem demands a response that is not limited to traffic or

transportation. A national and international strategy is required that articulates road safety education, safe urbanism, pre-hospital care, justice, and citizen participation. In cities such as Bogotá, this could translate into strengthening the "Vision Zero" approach, improving infrastructure in school and rural areas, and guaranteeing timely attention in the event of accidents. In short, Fernández recalls that road safety is not a technical or minor issue; it is a matter of human rights, equity, and dignity. Recognizing this is the first step to transforming mobility into a safe and fair experience for all.

5.8 Constant bicycle traffic on the roads of Bogotá

The analysis by locality shows relevant patterns in the distribution and characteristics of the cycling infrastructure in Bogotá. Chapinero, Usaquén, Santa Fe and Teusaquillo stand out for having the highest number of spaces in bicycle parking lots, which suggests greater attention to the parking needs for cyclists in these areas. As for public parking lots, a significant concentration is observed in Chapinero, Usaquén, Suba and Fontibón, which complements the offer of services for bicycle users. The bicycle path is consolidated as the dominant bicycle infrastructure in the city, followed by the unclassified, and to a lesser extent, the cycle bands.

The localities with the most active bike lanes include Teusaquillo, Santa Fe, Kennedy, Chapinero, Usaquén, Suba, and Engativá, which indicates a wide coverage of spaces for recreational or temporary bicycle use. On the other hand, Suba, Kennedy, Engativá, and Usaquén are positioned as the localities with the highest total cycling infrastructure, which may be related to their high population density and volume of trips. Finally, Kennedy has the largest number of neuralgic points, followed by Engativá, Usaquén, and Suba, which reinforces the need to prioritize these areas in terms of road safety and strategic planning of cycling mobility. (Monroy, 2025, p. 88).

Muñoz and Ávila (2023) state that the few studies regarding cyclists in the city of Bogotá generate the need to evaluate variables that are not taken into account in cycling infrastructure manuals or cyclist analysis, since the growth in the use of bicycles as a means of transport becomes very relevant over time. (p. 69).

The observation is especially pertinent in the context of Bogotá, where the use of bicycles has grown steadily, but research and planning have not yet managed to capture the complexity of the urban cycling phenomenon. Lack of studies: a critical gap, the scarcity of research on cyclists in Bogotá, limits the ability to design effective public policies, especially on issues such as road safety, connectivity, cycling behavior and citizen perception. This gap also affects the updating of technical manuals, which tend to replicate generic models without considering local variables such as topography, climate, road culture or usage patterns differentiated by gender and age. Emerging variables that should be included: subjective perception of safety (not only registered accidents). Interactions with other modes of transport, such as buses, motorcycles and pedestrians. Informal infrastructure conditions (sections without signage, improvised crossings).

This fragment evidences an important empirical validation of a previous institutional complaint: the research carried out by Bautista, García, and Sepúlveda (2024) confirms with concrete data what the Personería de Bogotá had already pointed out in 2022 about the structural deficiencies of bike paths. The fact that between 60 and 70% of the routes characterized lack cycling infrastructure not only reinforces the criticism about the lack of

continuity and interconnection with the public transport system, but also highlights a significant gap between urban planning and the real needs for sustainable mobility. This finding underscores the urgency of rethinking the design of cycling networks, integrating them more effectively with other modes of transport and guaranteeing adequate conditions for users. (p. 60).

5.9 Maintenance of cycle paths and bicycle routes

From the perspective of urban mobility and through a bibliographic review, the relevance of the bicycle as a means of transport that facilitates urban travel is analyzed, highlighting its benefits. Likewise, bicycle lanes are examined as infrastructures segregated from motorized traffic, identifying their types, users and uses, including their ability to connect urban habitats. The biodiversity present in these spaces is also addressed, its link with the landscape, trees and thermal comfort, as well as its positive impact on citizen health and safety. In addition, the bicycle path is considered as a tourist resource, a space for environmental education and an element of local identity. The study includes an approach to public investment in cycling infrastructure, the cost-benefit analysis of its implementation and the social agreements necessary for its development. Finally, the main problems associated with the design, operation and maintenance of bicycle lanes are synthesized, as well as their relationship with urban segregation phenomena and their potential to encourage the use of bicycles. (Crespo, 2022, p. 65).

The diagnosis revealed that the areas with the highest incidence of road accidents are concentrated on some main roads in the city, especially those where bike paths predominate and structural deficiencies or lack of continuity are evident. Previously, the intervention needs were interpreted based on the analysis of available data, considering variables such as the cause and type of accident, its severity, the temporality of the event, and the age range of the victims. This study provides strategic inputs for decision-making in the field of sustainable mobility, in coherence with the objectives of the Sustainable and Safe Mobility Plan of Bogotá and the principles of the smart city model. The findings strengthen the link between spatial analysis and urban management, and underscore the value of open data and geographic tools as key resources to improve the planning and operation of the cycle-infrastructure network. (Monroy, 2025, p. 10).

The conclusions of Enciso and Martínez (2024) highlight a significant advance in the use of technological tools for the management of cycling infrastructure. The implementation of MiRuta in the Android environment, with Firebase as a backend, not only demonstrates an efficient integration of functionalities for data collection, but also validates its ability to capture accurate and real-time information on the conditions of bike paths. This type of digital solutions represents a key contribution to strengthening evidence-based decision-making, optimizing infrastructure maintenance, and promoting safer and more sustainable mobility. In addition, it opens the door to new forms of citizen participation and collaborative monitoring of public space. (p. 33).

5.10 Crime control in transport and city streets

Crime is one of the main concerns in the daily lives of many inhabitants; it is a multifactorial problem. From geography, the spatio-temporal variable is incorporated, since crime is not a continuous phenomenon that is evenly distributed in geographical space; it is a discrete phenomenon that responds to particular characteristics from a spatial point of

view. (Flores, 2021, p. 25).

Flores' (2021) statement is very pertinent and opens a valuable door for the territorial analysis of crime. It must be recognized that it is a multifactorial and spatially discrete phenomenon that allows us to overcome simplistic approaches that explain it only from the social or legal perspective. From a geographical perspective, incorporating the spatio-temporal dimension not only helps to identify patterns of crime concentration, but also to understand how certain urban environments; for example, areas with low lighting, poor surveillance, or high segregation can facilitate its occurrence. This approach allows for the design of more precise public policies, such as interventions focused on critical points or situational prevention strategies. It also invites us to think about spatial justice, that is, how the unequal distribution of urban resources can influence exposure to crime. However, it is key not to fall into the stigmatization of territories, since spatial analysis must be accompanied by a deep social reading that considers community dynamics and structural causes.

The author Martínez (2022), to explore the perception that citizens who use the public transport service in the metropolitan area of Cuernavaca have, with respect to preventive policies against insecurity, to explore the citizen evaluation of them. The hypothesis was sought to test the hypothesis that the citizens of the Metropolitan Area of Cuernavaca (ZMC) are not satisfied with the existing public policies created to prevent crime in local public transport, as they believe that they are not effective for their purpose and this causes the weakening of trust towards local government institutions, generating illegitimacy of public action. A hypothesis that was affirmative. (p. 80).

The author's position reveals a critical and profoundly citizen view of the relationship between public security policies and social perception in urban contexts. By focusing his analysis on public transport users in the Cuernavaca Metropolitan Area (ZMC), the author not only addresses insecurity as an objective phenomenon, but also as a lived experience, which directly impacts institutional trust. It is based on a clear and socio-political hypothesis: that the population is not satisfied with existing preventive policies, and that this nonconformity erodes the legitimacy of the local government. His approach privileges citizen perception as an indicator of public evaluation, which is key in contexts where effectiveness is not measured only by crime statistics, but by the sense of security and institutional credibility.

The author seems to assume that the perceived ineffectiveness of policies not only affects security, but also fractures the link between citizens and institutions, which can have broader effects on urban governance. This approach is valuable because it recognizes that security is not only a technical issue, but also a relational and symbolic one. However, it would be interesting to complement this perspective with a look at the structural factors that limit the implementation of effective policies: are there sufficient resources, is there inter-institutional coordination, is the voice of users considered in the design of policies? It could also be explored whether perceived illegitimacy translates into forms of resistance, adaptation, or even alternative citizen proposals.

"Illuminated spaces, with a greater citizen presence and designed to guarantee community participation, create a sense of belonging that keeps them from becoming points of interest

for crime" (Fariña, 2023, p. 1). From the above, it can be deduced that the role of urban design in crime prevention is very well complemented by recent experiences in Bogotá, where the planning of public spaces has begun to incorporate criteria of environmental security, citizen participation, and territorial appropriation. In neighborhoods such as La Candelaria, Suba, and Kennedy, tactical urbanism projects have been implemented that include LED lighting, street furniture, community murals, and park recovery. These interventions have shown that when public space becomes visible, active, and cared for, the perception of insecurity decreases and the social fabric is strengthened. The "Parks for the People" program of the District Institute of Recreation and Sports [IDRD] and the "Citizen Culture" initiatives have promoted the collective use of spaces, generating dynamics of natural surveillance and constant presence of citizens, which reduces opportunities for crime.

In addition, studies by the Bogotá Security Observatory have shown that crime "hot spots" tend to coincide with areas of low lighting, little pedestrian activity, and little community ownership. This reinforces the idea that urban design can modify social behavior and deter crime. The participation of neighbors in the design and maintenance of public spaces such as urban gardens, neighborhood libraries, or cycle walks, not only improves safety, but also rebuilds trust in the collective. In this sense, urbanism with a gender focus has also been key: by considering the needs of women, children, and the elderly, more inclusive and safer environments are created for all.

5.11 Motorcycle Mobility Culture and Agile Transportation

A biased and stigmatizing value judgment about the people who ride them is frequently associated with the motorcycle, but beyond being a simple means of transporting people and objects, it was shown that it is a means of facilitating multiple opportunities with respect to the various urban and economic inequities that entire families must go through on a daily basis, where the use of other means of transport such as the bus or the car are often unfeasible because they are not within their reach. (Codutti, 2021, p. 60).

The author's reflection on the motorcycle as a stigmatized but functional vehicle in the face of urban inequalities is directly associated with the reality of the central region of Colombia, especially in cities such as Bogotá, Soacha, Chía and intermediate municipalities of the Cundiboyacense highlands. In Bogotá and its surroundings, the motorcycle has acquired a key role as a vehicle of economic access, especially for informal workers, homeowners, technicians, and families living in peripheral areas with limited public transport coverage. In neighborhoods such as Ciudad Bolívar, Usme or Soacha, the use of motorcycles responds to the need for flexible, fast and affordable mobility, compared to long and expensive journeys in TransMilenio or collective buses.

Despite its usefulness, there is a negative perception fueled by the media and institutional discourses that associate the motorcycle with crime or road disorder. This generates social stigmatization towards those who use it, making its role as a tool for urban inclusion invisible. In intermediate cities such as Ibagué, Honda or Fusagasugá, the motorcycle also represents a solution to the fragmentation of the transport system, allowing many people to access services, employment and education without depending on scarce or expensive routes. Recognizing the motorcycle as a vehicle for urban resilience implies reviewing mobility policies from a more inclusive perspective, which does not criminalize use but regulates it

fairly. This opens the door to proposals such as: safe zones for motorcycles, maintenance subsidies, community road training, and above all, a public narrative that values its role in the fight against territorial inequality.

Broadening the perspective, the authors Herrera, Grajales, and García (2021) report on the existence of a "mobile application that allows requesting a transport service (motorcycle taxis, motorcycle cart, carpati) through geolocation for access to transport services in the municipality of Belén de Umbría." (p. 70). From the above, if it adapts to the regulatory, territorial, and social conditions of the metropolitan context. In Bogotá, the use of motorcycle taxis is prohibited by national legislation, but there are informal experiences in neighboring municipalities such as Soacha, Mosquera, or Chía, where demand exceeds the formal supply of transportation. Geolocation is already widely used in platforms such as Picap, Didi, and Uber Moto, although many operate in legal gray areas. This indicates that the technological infrastructure exists, but requires differentiated regulation for rural or urban edge areas. Bogotá as a city-region includes municipalities with diverse public transport coverage, where an application such as the one described could complement the formal system, especially on short journeys, areas of difficult access or night schedules.

A pilot model could be designed in localities such as Usme, Ciudad Bolívar or Sumapaz, where conventional transport is limited and topographical conditions favor light vehicles. The application must incorporate criteria of safety, traceability and regulated rates, in addition to promoting the progressive formalization of drivers. It can also include community alert functions, service evaluation and safe routes, strengthening citizen confidence. The technology consists of an App with geolocation, interoperable with SITP and TransMiApp. Motorcycle taxi and motorcycle vehicles in rural areas or urban areas. Pilot legality with the support of local mayors and regulatory review. Security with driver registration, emergency button, traceability on inclusion, affordable rates, gender focus and community participation.
The PPP that promotes knowledge of the traffic code and the monitoring of the comparendos process is strategically linked to what has already been made viable for Bogotá as a Region City, especially in the framework of a more inclusive and regulated mobility. In the previous analysis, the feasibility of a geolocation APP for motorcycle taxis and alternative transport in peripheral areas of Bogotá was raised. Integrating Ortiz's proposal would strengthen this platform with an educational and legal component, promoting the progressive formalization of drivers. This complementary APP could function as a module within the same platform, offering: Interactive micro-courses on specific traffic rules for motorcyclists. Registration of comparendos and monitoring of the sanctioning process, with alerts and legal guidance. Validation of drivers to ensure that those who provide alternative services are informed and comply with the regulations.

In towns such as Soacha, Usme, Suba, Kennedy or Ciudad Bolívar, where the use of motorcycles is high and often informal, this tool can be key to reducing stigmatization, improving road safety and rebuilding trust between citizens and institutions. In addition, by linking the APP with entities such as the Ministry of Mobility or the Traffic Police, access to official information, virtual conciliations and simplified procedures can be facilitated. The integrating proposal: it would have functional components in the APP, geolocation, request for alternative transport in hard-to-reach areas, road education, short and gamified courses on traffic rules, legality, monitoring of comparendos, alerts and guidance, security,

validation of drivers and traceability of trips, inclusion of access for users with low connectivity or digital literacy. "an interactive APP for motorcyclists with the aim of disseminating the correct application of the 0 traffic code and monitoring due process in the adjudication of a comparendo" (Ortiz, 2022, p. 9).

6. CONCLUSIONS

The definition of a city-region with adequate mass transport infrastructure is an essential step to address the imbalance between the accelerated growth of Bogotá and the backwardness of its surrounding municipalities. The proposal presented demonstrates that it is possible to build an articulated, efficient and sustainable regional mobility system, through the implementation of megaprojects that integrate criteria of territorial equity, technological innovation and metropolitan planning. This vision of the city-region makes it possible to overcome institutional fragmentation and move towards a fairer, more resilient and connected urban development model.

The historical and current analysis of the chaos in urban and regional transport reveals that the difficulties in mobility and connectivity between cities are the result of multiple structural factors: disorderly expansion, lack of intermunicipal coordination, obsolete infrastructure, and absence of integrated policies. This diagnosis made it possible to identify critical patterns and formulate road infrastructure proposals based on megaproject models that respond strategically to urban growth, promoting sustainable solutions that positively impact quality of life and regional competitiveness.

The design of the strategic plan for international and scientific cooperation has made it possible to establish key alliances with urban planning and mobility entities in Europe and Latin America, as well as with universities specializing in infrastructure and transport. These collaborations strengthen the technical base of the project, enrich its multidisciplinary approach and guarantee the dissemination of its advances in academic and specialized spaces. The international articulation not only provides expert knowledge, but also positions the Central Region as a benchmark in innovation and collaborative territorial planning.

The implementation of comprehensive actions in safety, accessibility, and sustainability of transportation has proven to be fundamental to transform the mobility experience in the Central Region. The construction of immediate attention posts, the conditioning of cycle routes and spaces for motorcycles, and the strengthening of road culture and the prosecution of crimes, contribute to a safer, more inclusive, and efficient system. These measures, aligned with international standards, consolidate mobility focused on people and collective well-being, with the capacity to respond to contemporary urban challenges.

A city-region with adequate mass transport infrastructure can be defined as one that territorially articulates the capital city with its surrounding municipalities through efficient, accessible and sustainable mobility systems, capable of balancing the dynamics of urban growth and regional development. This definition implies: Functional integration of infrastructure must seamlessly connect urban centers, reducing travel times and promoting economic, social and cultural complementarity between territories. Multilevel planning that requires coordination between local, regional and national governments, with territorial planning instruments that recognize the interdependence between the central city and its surroundings. Equity in access, sharing mass transport that must guarantee coverage for

peripheral populations, with fair fares and conditions that favor social inclusion and daily mobility.

In terms of sustainability and resilience, infrastructure must respond to environmental criteria, adapt to climate change, and promote non-motorized modes of transportation such as bicycles and walking. In short, a well-defined city-region from its mass transportation infrastructure not only faces uneven growth, but also transforms it into an opportunity to build more connected, equitable, and sustainable territories. All this resolves the research question: How can a city-region be defined with adequate mass transportation infrastructure that allows it to face the accelerated growth of the capital city and the lag in the development of its surrounding cities?

In short, the difficulties in mobility and mass transport cannot be addressed with isolated or reactive measures. A long-term vision is required, supported by technical evidence, inter-institutional cooperation and political will, to consolidate an efficient, safe and sustainable transport system for the entire Central Region of Colombia.

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