TC Document

I. Basic Information for TC

▪ Country/Region:	COLOMBIA
▪ TC Name:	Artificial Intelligence models for congestion prediction and optimal traffic management in Bogotá
▪ TC Number:	CO-T1784
▪ Team Leader/Members:	Ariza Donado, Natalia (INE/TSP) Team Leader; Campos Lombeida, Liseth Antonella (INE/TSP); Riobo Patino, Jairo Alexander (INE/TSP); Allmi Natalia (INE/TSP); Jimenez Mosquera, Javier I. (LEG/SGO); Ferro Briceno Paula Vanessa (INE/TSP); Tovar Farfan Sergio Raul (INE/TSP); Gomez De Las Heras, Eduardo (INE/TSP); Urquijo, Lee (ITE/IPS); Pfeifer Vargas Maria Angelica (INE/INE); Lamagni, Mariano Javier (ITE/IPC)
▪ Taxonomy:	Client Support
▪ Operation Supported by the TC:	.
▪ Date of TC Abstract authorization:	08 Oct 2024.
▪ Beneficiary:	Secretaria de Movilidad de Bogotá
▪ Executing Agency and contact name:	Inter-American Development Bank
▪ Donors providing funding:	OC SDP Window 2 - Economic Growth(W2F)
▪ IDB Funding Requested:	US$220,000.00
▪ Local counterpart funding, if any:	US$0
▪ Disbursement period (which includes Execution period):	27 months
▪ Required start date:	November 2024
▪ Types of consultants:	Individuals, Firms
▪ Prepared by Unit:	INE/TSP-Transport
▪ Unit of Disbursement Responsibility:	CAN/CCO-Country Office Colombia
▪ TC included in Country Strategy (y/n):	No
▪ TC included in CPD (y/n):	No
▪ Alignment to the Update to the Institutional Strategy 2010-2020:	Productivity and innovation; Institutional capacity and rule of law; Environmental sustainability; Gender equality
▪ IDB Group Institutional Strategy: Transforming for Scale and Impact:	Objectives: (i) addressing climate change and (ii) bolstering sustainable growth. Focus areas: (i) biodiversity, natural capital and climate action; (ii) gender equality and inclusion of diverse population groups; (iii) institutional capacity, rule of law and citizen security; and (iv) sustainable, resilient and inclusive infrastructure.

II. Objectives and Justification of the TC

2.1 This Technical Cooperation (TC) aims to enhance traffic flow prediction and optimization in Bogotá by leveraging artificial intelligence (AI) as a key tool, utilizing existing data resources for traffic management and transportation planning, and establishing a clear pathway for AI integration into mobility management.

2.2 Mobility in Bogotá faces significant challenges due to population growth, high levels of motorization, and rapid urbanization. The city ranks among the most congested in the world. Despite efforts made by authorities to promote public transportation, mobility

conditions have worsened, with the average speed of public transport dropping from 19.2 km/h to 16.6 km/h between 2010 and 2015. As a result, the increase in travel times on mass transit had led to a loss in productivity for the city of 172,000 hours per day. Furthermore, higher congestion levels lead to more contamination and air pollution, affecting climate change and citizens' quality of life. In 2021, the city of Bogotá emitted a total of 9,528,152 tons of CO2 equivalents, of which the transport sector accounts for 40%[1] and in that same year 8% of all premature deaths were linked to exposure to the pollutant PM2.5.[2]

2.3 Gender and diversity: Women represent 51.5% of the population in Bogotá and make approximately 4 million daily trips. Females have different mobility patterns from their male counterparts', largely due to their caregiving responsibilities and safety concerns. Women make 8.7 million travels per day, of which 72% is either by walking or public transportation.[3] Women from lower socioeconomic strata may have travel times up to 11 minutes longer than men.[4] For female heads of household, the percentage rises to 85%. Regarding caregiving trips,[5] 90% of them have a supporting woman.[6] Considering their proportion among pedestrians or public transport users, particular mobility patterns of women, including the mobility of care, must be addressed in the transport data collection and relevant policies, while traditional transportation planning focused on the commuting hours. About 85% of participants in a 1,000-women online survey reported having suffered sexual harassment while traveling in the city across all transport modes.

2.4 Meanwhile, in Bogotá, 437,000 people reported having some form of disability.[7] They make up 6% of Bogotá's population, and 16.5% of the country's population with disabilities resides in Bogotá. The gaps in accessibility to public transport for this population in Bogotá are significant, and even more profound for those in lower socioeconomic status. According to the 2019 mobility survey, people with reduced mobility make 1,246,781 trips per day. The survey also indicates that people with reduced mobility in higher socioeconomic strata tend to use cars and taxis, while those in lower strata primarily walk or use public transport. Regarding road safety, between 20 and 50 million people globally are injured in non-fatal traffic accidents each year, and many of them acquire disabilities because of their injuries.[8]

2.5 AI is a cross-cutting tool to improve congestion management. Investing in AI and innovative technologies supports the development of sustainable and resilient infrastructure, providing benefits such as increased productivity, process automation, new services and products, optimized asset management, cost reduction, improved transparency with the public sector, more efficient decision-making, and greater user empowerment in transport services.

2.6 AI can significantly enhance urban mobility in Bogotá. AI-based models use vast amounts of data, such as real-time traffic patterns, historical trends, and public transport usage, to forecast congestion points and traffic flow. By predicting areas of

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1 Inventario de emisiones y absorciones de gases de efecto invernadero 2019, 2020 y 2021. Secretaría de Ambiente de Bogotá, 2023.

2 Primera operación individual bajo la CCLIP para la Primera Línea del Metro de Bogotá Tramo I. Monter, E., Durán, M., Sanz, N., Rodríguez, M. y Pereyra, A. IDB, 2018.

3 Encuesta de Movilidad Bogotá. Región, 2023.

4 Moscoso et al., 2020.

5 Trips with the purpose of providing care, assistance, or support to family members or dependents (such as going to educational centers, medical facilities, or purchasing medicine).

6 Encuesta de Movilidad Bogotá. Región, 2023.

7 DANE, 2020.

8 WHO, 2023.

bottlenecks or potential delays, AI can help city planners and authorities make data-driven decisions to optimize traffic management and urban investments, improve transportation planning and implement informed transportation policies. The actions derived from data-driven decisions can include adjusting traffic signals, enhancing public transportation routes, and prioritizing infrastructure improvements. Additionally, this initiative can significantly reduce congestion, improve air quality, and increase economic efficiency. These enhancements will lead to safer, more reliable transportation, better public health, and higher quality of life for residents. [9]

2.7 AI will aid this process by analyzing and interpreting data provided and collected by the Secretaría de Movilidad de Bogotá and the IDB, employing tools like video analytics for congestion measurement and incorporating data from platforms such as Waze, GPS tracking, vehicle movements, and public transport usage.

2.8 The TC is aligned with the IDB Group Institutional Strategy: Transforming for Scale and Impact (CA-631), specifically to the following objectives: (i) addressing climate change: by seeking to reduce road saturation through decreased use of private cars to mitigate congestion, thereby reducing emissions; and (ii) bolstering sustainable growth: by reducing travel times, enhancing people's quality of life and facilitating their integration with surrounding cities, and increasing the city's productivity with logistics and transportation optimization.

2.9 Furthermore, it is aligned with the focus areas: (i) biodiversity, natural capital and climate action, by leveraging AI to improve traffic management, contributing to emission and congestion reduction and ensuring a safer environment and higher quality of life for citizens; (ii) gender equality and inclusion of diverse population groups, by promoting public policies that integrate a gender perspective; (iii) institutional capacity, rule of law and citizen security, through the technical strengthening of Secretaría de Movilidad de Bogotá, improving its institutional capacity in decision-making and the implementation of transportation policies to benefit citizens and private sector development; and (iv) sustainable, resilient and inclusive infrastructure, promoting the use of digital infrastructure and emerging technologies for data gathering and analysis, resulting in improved decision-making, more effective policies, and optimization of infrastructure use. The TC is also consistent with the Ordinary Capital Strategic Development Program (OC SDP) – Window 2 (W2F) (GN-2819-17), in the priority area of Inclusive Economic Growth.

2.10 The TC is consistent with the Colombia Country Strategy (GN-2972) in the strategic area of economic productivity by enhancing innovation, digital ecosystems, and optimization of infrastructure use through digitalization; and the cross-cutting theme of Digital Economy by supporting digital transformation in public service delivery. In addition, the TC is aligned with the Plan Nacional de Desarrollo Colombia 2022-2026, in the section “Productive Transformation, Internationalization and Climate Action”, specifically with the catalyst technological ascent of the transport sector and promotion of active mobility, by promoting operational and energetic efficiency in transport modes. At the local level, the TC is also aligned with the Plan Distrital de Desarrollo 2024-2027, specifically with Program 18, which seeks to consolidate Bogotá as a Technological Innovation Hub, through financing and coordination with organizations that allow the adoption and transfer of knowledge and results to improve the quality of life.

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[9] Cómo aplicar Big Data en la planificación del transporte: El uso de datos de GPS en el análisis de la movilidad urbana. Gutiérrez, J., Benítez, C., García, J., Romanillos, G. y Rubinstein, E. IDB, 2020.

III. Description of activities/components and budget

3.1 The TC will develop AI-based models for traffic prediction and management in Bogotá. It leverages data from the Secretaría de Movilidad de Bogotá and tools from the IDB, such as video analytics and congestion measurement with Waze, to improve congestion analysis and optimize infrastructure deployment. Building upon existing and newly developed AI models, the project seeks to create a robust system for identifying and addressing high-congestion areas effectively. Additionally, the project will strengthen the capacities of the Secretaría de Movilidad de Bogotá regarding data collection, storage, integration, and security and enhance the integration of these systems into the entity's processes.

3.2 The TC will finance two components:

3.3 **Component 1:** Data treatment and AI model. This includes all the necessary activities related to data and the AI model. Key activities include: (i) collecting, preparing and integrating traffic data (speed and volume); (ii) developing an AI-based congestion model; (iii) testing the model and evaluating traffic management measures; and (iv) training and adoption. The project will also examine international AI integration methods to propose strategies for local traffic management and planning. The AI model considers an initial basic model of machine learning, which will increase its complexity gradually to identify an optimal model. It will include supervised and unsupervised learning, considering the specific characteristics of the problem, data, available technology and time constraints. Machine learning will also be implemented through clustering models and light gradient boosting machine. A Design Thinking workshop will be developed to address the existing information, needs, objectives and goals of the beneficiary. The component also includes the Design and adaptation of public policies for data and traffic management based on an AI congestion model for Secretaría de Movilidad de Bogotá, including mainstreaming of gender and inclusion perspective. This will help ensure that the needs of these subgroups are reflected in traffic management strategies. The elaboration of public policy will include recommendations for congestion measurements, infrastructure improvement and data collection. Regarding gender, these will consider corridors with high demand of public transportation in majority used by women based on the mobility patterns of women. Regarding Persons with Disabilities (PwD), the recommendations will consider high pedestrian crossings adaptation to PwD considering the crossing times or walking speeds at measures of collision risks at intersections and crosswalks.

3.4 **Component 2:** Training, knowledge, and dissemination. This component will finance training sessions, courses or workshops with the Beneficiary, reinforcing the applicability and sustainability of the model development; and its capacities regarding data collection, storage, integration, and security The component will also finance the dissemination of the findings and lessons learned from the tool development.

3.5 The total budget for this Technical Cooperation is US$220,000 and will be financed by the OC SDP Window 2 - Economic Growth (W2F) fund, with no local counterpart. The operation’s resources will be disbursed and executed over a 27-month period. The project budget is as follows:

Indicative Budget (US$)

Activity /Component	Description	IDB/Fund Funding	Total Funding

Component 1: Data treatment and AI model	Consultancy services for general data gathering, preparation and integration	22,500	22,500
	Consultancy services for data gathering in small data sets, preparation and integration	22,500	22,500
	Consultancy services for the design, development, testing, and evaluation of deep learning models using AI for congestion prediction and traffic management optimization	50,000	50,000
	Consultancy services for the design, development, testing, and evaluation of machine learning AI-based and statistical models for congestion prediction and traffic management optimization	50,000	50,000
	Consultancy services for the management of an AI-based model for congestion prediction and traffic management optimization	20,000	20,000
	Consultancy services for the design and adaptation of public policies for data and traffic management based on an AI congestion model for Secretaría de Movilidad de Bogotá, including recommendations for integrating gender and inclusion perspective	20,000	20,000
	Consultancy services for Accompaniment and Supervision of the Execution of the Technical Cooperation "AI Models for Congestion Prediction and Optimal Traffic Management in Bogotá"	10,000	10,000
	Implementation of Design Thinking Methodology in the Secretaría de Movilidad including mainstreaming of gender and inclusion perspective	5,000	5,000
Component 2: Training, Knowledge and Dissemination	Training and dissemination workshops	20,000	20,000
Total		**220,000.00**	**220,000.00**

3.6 Expected outcomes include more predictions and correlated variables with precise measures for congestion management, intelligent traffic control, transport infrastructure planning, and demand management.

3.7 The implementation of these measures is expected to result in: (i) improvement of traffic flow and congestion levels; and (ii) reduction in travel times and air pollutants.

3.8 The TC is expected to benefit all the population of the region of Bogotá, with 9.27 million of habitants[10]. This scope of beneficiaries considers the benefits of a strengthened Secretaría de Movilidad de Bogotá, which will be able to progressively implement congestion management tools based on AI models throughout the entire city. It also includes neighboring municipalities, since they have become satellite areas, and those who work in Bogota every day are impacted by congestion.

IV. Executing agency and execution structure

4.1 The execution of the Technical Cooperation (TC) will be carried out by the Bank through the Transport Division (INE/TSP). The Bank will hire the services of individual consultants, consulting firms, and non-consulting services in accordance with the Bank's current policies and procedures. All acquisitions to be executed under this TC have been included in the Procurement Plan (Annex IV) and will be contracted in accordance with the applicable policies and regulations of the Bank as follows: (i) Hiring of individual consultants, as established in the policy on Complementary Workforce (AM-650); and (ii) Hiring of services provided by consulting firms in accordance with the Corporate Procurement Policy (GN-2303) and its Guidelines. INE/TSP will be responsible for the preparation and publication of calls for expressions of interest, the preparation of shortlists, the preparation and distribution of requests for proposals, the evaluation and selection of consultants based on the criteria established in the requests for proposals, and the negotiation of the respective contracts.

4.2 Additionally, the Bank, as executor, will be responsible for contract administration, approvals, reports, payments, and the evaluation of consultancies. Besides the components mentioned above, it is expected that IDB staff and the consultants and firms hired will provide specialized technical knowledge and firsthand expertise in the activities to be implemented within the components of this TC.

4.3 The Bank's execution structure is justified by the highly technical nature of the activities and the need for a high level of coordination and interdependence for proper implementation. Moreover, the Bank, specifically INE/TSP, has the technical expertise and capacity to ensure high-quality products and activities; the Bank's execution will also facilitate coordination among the multiple public agencies from which information is required and that will benefit from the products obtained in this TC. Furthermore, according to Annex II of Document OP-619-4 and the TC Policy (GN-2470-2), the Bank's execution is justified because the requesting entity does not have the necessary technical, operational, or institutional capacity to properly and timely execute the activities planned in the respective project. Additionally, compliance with internal requirements would delay the execution of the TC, jeopardizing the achievement of its objectives.

V. Major issues

5.1 No major risks have been identified for the execution of this TC. Some existing minor risks include: (i) data availability: the lack of data availability and accessibility to

[10] Persons with 5 years old or above. Encuesta de Movilidad de Bogotá. Región, 2023.

develop the AI model could constitute a potential challenge. This risk will be mitigated by conducting a thorough inventory of existing data sources available through the IDB and within the Secretaría de Movilidad de Bogotá, and by developing data validation and certification; (ii) integration of technological tools: the successful adoption of the developed tools within the Secretaría de Movilidad de Bogotá could pose a challenge. This can be mitigated by elaborating a change management plan and executing knowledge and dissemination activities, including knowledge transference workshops and training sessions for public officials; (iii) knowledge transfer: ensure this process in the context of potential high turnover in administrations constitute a challenge. This is a risk common to every process of capacity building and knowledge transfer. To mitigate the risk, the team in coordination with beneficiaries will select staff with long-term stability in the institution (i.e., public servant status) and ensure to document each process (record workshops, elaborate completion reports, etc.), for the long term, the project will develop user manuals and guides for new administrations; (iv) stakeholder engagement: lack of stakeholder engagement and participation can impede the timely execution of the TC. This will be mitigated by implementing effective communication strategies, scheduling regular meetings to facilitate dialogue, and continuously monitoring the completion of activities.

VI. Exceptions to Bank policy

6.1 Exceptions to Bank policy are not considered.

VII. Environmental and Social Aspects

7.1 This Technical Cooperation is not intended to finance pre-feasibility or feasibility studies for specific investment projects or the associated environmental and social studies. Therefore, this TC does not have applicable requirements from the Bank's Environmental and Social Policy Framework (ESPF).

Required Annexes:

Request from the Client_35895.pdf

Results Matrix_70603.pdf

Terms of Reference_82637.pdf

Procurement Plan_8948.pdf