Prosperity Fund

GLOBAL FUTURE CITIES PROGRAMME

BELO HORIZONTE

CITY CONTEXT REPORT

Foreign & Commonwealth Office

UN HABITAT
FOR A BETTER URBAN FUTURE

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BELO HORIZONTE
City Context Report

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GLOBAL FUTURE CITIES PROGRAMME

Introduction

ABOUT THE GLOBAL FUTURE CITIES PROGRAMME

In 2015, the UK government created a new Cross-Government Prosperity Fund worth £1.3 billion from 2016-2021, in order to help promote economic growth in emerging economies. Its broad priorities include improving the business climate, competitiveness and operation of markets, energy and financial sector reform, and increasing the ability of governments to tackle corruption.

Emerging Economies still face considerable challenges such as uncontrolled urbanisation, climate change and high and persistent inequality which can lower long-term growth prospects. The Prosperity Fund supports the broad-based and inclusive growth needed to build prosperity and reduce poverty, but also make development overall more sustainable through the strengthening of Institutions and Improvement of the global business environment.

The Global Future Cities Programme (GFCP) is a specific component of the Prosperity Fund which aims to carry out targeted interventions to encourage sustainable urban development and increase prosperity whilst alleviating high levels of urban poverty. The programme will also create significant short and long-term business opportunities in growing markets, forecast to be regional growth hubs, including for UK exporters who are world recognised leaders in urban innovation.

The overall strategy of the Global Future Cities Programme is to deliver the Programme in two phases; a strategic development phase (2018), followed by an implementation phase (2019-2021). UN-Habitat, in collaboration with the International Growth Centre (IGC) and the UK Built Environment Advisory Group (UKBEAG), has been mandated by the UK Foreign and Commonwealth Office (UK FCO) to develop and undertake the strategic development phase. This in turn, will inform and shape the implementation phase, and collectively provide further evidence for the overall programme.

The Programme builds upon a coherent series of targeted interventions in 19 cities across 10 countries, to support and encourage the adoption of a more sustainable approach to urban development. In general, the proposed interventions aim to challenge urban sprawl and slum developments, thereby promoting more dense, connected and inclusive cities that in combination contribute to prosperity, achieving the Sustainable Development Goals (SDGs) and implementing the New Urban Agenda (NUA).

The Global Future Cities Programme builds upon three integrated pillars, that will address key barriers to prosperity, in selected cities:

- **Urban planning** – technical assistance for spatial restructuring (Public space, Heritage and urban renewal, Urban strategies and plans, Data systems for integrated urban planning);
- **Transportation** – technical assistance to support cities to develop integrated transport systems (Multi-modal mobility strategies and plans, Data systems for multi-modal mobility);
- **Resilience** – technical assistance to develop strategies to address the impact of climate change and ensure development is sustainable (Flood management plans and systems).

In order to capitalize on the proposed interventions and to ensure sustainability and impact in a longer-term perspective, the programme has a strong focus on technical support and institutional capacity development.

In many of the interventions, there is a particular focus on the potential of embedding smart/digital technology and data analysis platforms in urban governance and management processes. Integrating smart technologies is recognized as an instrumental area that significantly can improve the efficiency in the provision of key infrastructure services, enhance urban resilience, support evidence-based plans and strategies and promote integrated planning approaches across sectors.

INTERVENTION DEVELOPMENT AND VALIDATION

Based on initial scoping studies and government-to-government engagement carried out by UK FCO, the UN-Habitat team worked with partner local authorities and wider stakeholders to corroborate their city development strategies, and to confirm, enhance and develop the intervention proposals.

In each city, a Local City Specialist, supported by the national and regional country offices of UN-Habitat

and in liaison with the FCO local posts, took the lead in identifying stakeholders in a series of bilateral meetings, interviews and focal group discussions. This has collectively gathered information and provided more detailed knowledge and information on the City's visions and goals.

Based on this initial phase, a Charrette (planning workshop) involved high-level decision-makers from the public and private sectors together with civil society representatives. This facilitated discussion on the proposed and possible alternative interventions, related individual interests, technical opportunities and constraints, as well as political objectives. The outcome of the Charrette provided clarity on where stakeholders stand in relation to the strategic potential of the discussed projects and it allowed for the mobilisation of support.

At the same time, the Charrette allowed for the technical teams to proceed with the development of a Terms of Reference, outlining the specific scope and activities of each intervention. A final Validation Workshop assured consensus on the proposed projects and document's endorsement by the authorities.

Parallel to preparing the Terms of Reference, an evaluation of the interventions was initiated, aiming to address its feasibility within the local strategic context, identify potential impact on prosperity barriers and to explore the optimal delivery models. This process resulted in a set of City Context Reports as well as an analysis of the technical viability of the interventions. The analysis aimed at both informing the development of the Terms of Reference and the future implementation phase of the Programme.

THE CITY CONTEXT REPORT

Objectives

A City Context Report is provided for each city of the Global Future Cities Programme. It serves as a tool to frame the proposed Programme interventions within the characteristics and pre-conditions of each city.

The Report targets a variety of stakeholders in the Programme: administrators, city managers, policy makers, legislators, private sector actors, donors, and local as well as international researchers and knowledge generators. The Reports also provide UKFCO the contextual setting of each proposed intervention, and can in addition, be used by the Service Providers as an entry point for the implementation phase.

By addressing the specific challenges facing each city, the Report illustrates how the interventions can work towards inclusive prosperity and sustainable urban development. The benefits of each intervention, however, cannot be achieved without certain enabling conditions to ensure its success. Therefore, critical aspects for the delivery of the proposed interventions and its success from a long-term perspective are outlined. Using thematic

best practices and evidence from global learnings and research, contextualised recommendations are provided on the conditions necessary for the intervention to be viable and to reach a maximum impact.

Essentially, the City Context Report serves to ensure that all actors within the Global Futures Cities Programme are aware of the specific conditions to be considered in the delivery of the proposed interventions, on a case-by-case basis.

Set-up and Scope

The first part of the City Context Report (General Overview) provides an overview of the Global Future Cities Programme and introduces the city from the perspective of the urban challenge which the proposed intervention intends to address.

The second part of the Report (Urban Analysis) more critically and technically analyses a selection of factors which need to be considered or to be in place for the intervention to succeed, addressing its feasibility, potential impact on prosperity barriers from a long-term perspective.

The third part of the Report (International Alignment and Technical Recommendations) presents short–and mid-term expected outcomes as well as long-term potential impacts. It further elaborates the contribution of the intervention to the achievement of the SDGs and the implementation of the New Urban Agenda as well as the programme objectives of the Prosperity Fund.

As the City Context Report is tailored directly to the Programme interventions, the analysis does not aim to comprehensively present all aspects of urban development. It does not elaborate on long term planning and transformation strategies, the effectiveness of policy or urban legislation, nor the entire municipal financial system. As such, it also excludes urban policy recommendations.

However, the Report has the scope to illustrate the general capacity of the city for project delivery, and in this regard, make recommendations to support implementation of the interventions and reaching set goals. The City Context Reports will be part of knowledge management for the Programme to generate local information and data on the cities as well as identify gaps in knowledge, systems or governance.

Methodology

Urban Analysis

The City Context Report provides a general analysis of the spatial, financial and legal conditions in the city that can either facilitate or hinder the implementation and the long-term sustainability of the proposed interventions in transport, resilience and urban planning.

This framework follows UN-Habitat's three-pronged approach, recognising the three essential components for a successful and sustainable urbanisation: 1. urban planning and design; 2. urban economy and municipal finance; 3. urban legislation, rules and regulations.

Firstly, the spatial analysis describes the existing urban context specific to the intervention. Urban mobility systems, vulnerability of the built environment, spatial form and trends are considered as possible challenges in urban management that the intervention can address.

Secondly, the financial analysis aims to identify the mechanisms in place by which the intervention could be sustainably financed in the long-run. This section outlines the city's municipal capacity, existing regional, national and international financial ecosystem and existing financing mechanisms at the municipal level.

Thirdly, from a legal perspective, the Report critically analyses how the intervention could be facilitated or challenged by the vision of the city and its governance hierarchy. Enablers and obstacles resulting from any relevant legislation, as well as sectoral frameworks (e.g. strategies, policies, planning frameworks and development plans, detailed plans of relevance) are also described.

This approach aims to offer implementing partners, stakeholders and donors a general context of the city and, with it, demonstrate the appropriateness of the intervention from a spatial, financial and legal point of view, while at the same time informing about potential barriers and enablers for its implementation.

Potential Impact to the Program Objectives and the SDGs

The Report also outlines the potential impact of the interventions, based on the specific activities and outputs proposed. Impact can arise from a complex interaction of context-specific factors, rather than as result of a single action, which makes it difficult to empirically quantify longer-run effects that go beyond the identification of program outputs. An empirical, comprehensive impact assessment is therefore not part of the scope of this report.

Nevertheless, the report outlines potential benefits that are only achievable under certain preconditions and activities. Thereby, short-, medium- and long-term outcomes are defined with reference to a project-cycle approach, which considers all the project phases from

Planning and Design through *Building*, to *Operating and Maintaining.*

Short-term outcomes are directly achieved through the implementation of the technical assistance support, within the 2-3 years scope of the Global Future Cities Program.

Mid-term outcomes are only realised once the intervention is executed through either capital investment, implementation of pilot projects or the actual enactment of legal documents, plans or masterplans, within a possible timeframe of 3 to 7 years.

The broader long-term impact of the interventions is linked to the sustainability of the interventions in a 7-15 years timeframe and relates to the operation and maintenance phase of the project cycle.

The City Context Reports further connect potential impacts to the Programme's objectives, taking into account also the Cross-cutting issues at the core of UN-Habitat's mandate from the UN General Assembly. Consequently, the Programme's objectives are summarized into five principles:

- Climate Change;
- Gender Equality;
- Human Rights;
- Youth;
- Sustainable and Inclusive Economic Growth.

Cross-cutting issues are addressed with explicit reference to the 2030 Sustainable Development Goals (SDGs) and the New Urban Agenda, in an attempt to ensure that the proposed interventions are in line with the design, implementation, review and success of the 2030 Agenda for Sustainable Development. Consistent with UN-Habitat's mandate, the SDG 11 Sustainable Cities and Communities is linked with the urban dimension of the other 16 goals as an essential part of the localisation of the SDGs. In this way, interventions can support localisation processes, to support local ownership and ensure SDG integration in sub-national strategies and plans.

Technical Recommendations and International Best Practices

The interventions proposed in the various cities of the Global Future Cities Programme were grouped into clusters according to their thematic entry-point, as an elaboration of the thematic pillars of Urban Planning, Transport and Resilience.

These clusters are:

- Public space
- Heritage and urban renewal
- Urban strategies and plans
- Data systems for integrated urban planning
- Multi-modal mobility strategies and plans
- Data systems for multi-modal mobility
- Flood management plans and systems

Combining the international experience in urban policy and project implementation of UN-Habitat and the leading academic research of IGC, each cluster was analysed to offer evidence-based recommendations for a successful Implementation and a maximised impact of the intervention. Specific reference was given to implemented plans and international best practices.

The recommendations inform the Planning and Design phase which coincides with the timeframe of the Global Future Cities Programme, and always aim for long-term sustainability of the interventions.

Fig. 1. Sao Francisco de Assis Church, one of the most iconic buildings in Belo Horizonte (Source: Francesco Tonnarelli, UN-Habitat)

Belo Horizonte

Belo Horizonte is the sixth-largest city in Brazil and is embedded within the third-largest metropolitan area. It is in the state of Minas Gerais; that, together with the states of São Paulo and Rio de Janeiro, forms the richest and most urbanised area of the country, where 43 per cent of the national population lives. This area hosts one of the most developed transport infrastructure systems (highways, railways, airports and ports) of South America.

The metropolitan region of Belo Horizonte (RMBH), constituted of 34 municipalities, hosts more than five million people, and is growing steadily in population, at more than 1 per cent per year.[1] More than 600,000 people live in the Metropolitan Belt of 16 municipalities. While most towns are small- or medium-sized, 69 per cent of the total population is concentrated in the municipalities of Betim (pop. 427,904), Contagem (pop. 652,660) and Belo Horizonte, which is the main city with a population of 2.36 million. Belo Horizonte is also the physical core of the region and the main destination and point of transit for any means of transportation. However, the State aims to develop a system to make the Metropolitan Region into a polycentric area and integrate the existing railways, railroads and metro lines for the integrated development of RMBH.[2]

Urbanisation processes are leading to significant pressures on infrastructure, housing and basic services. Despite a good system of urban economy, governance, planning and delivery capabilities, current urbanisation trends could lead to wide-ranging detriments to many sectors, including food and water systems, human health, buildings, transport, energy and ecosystems.

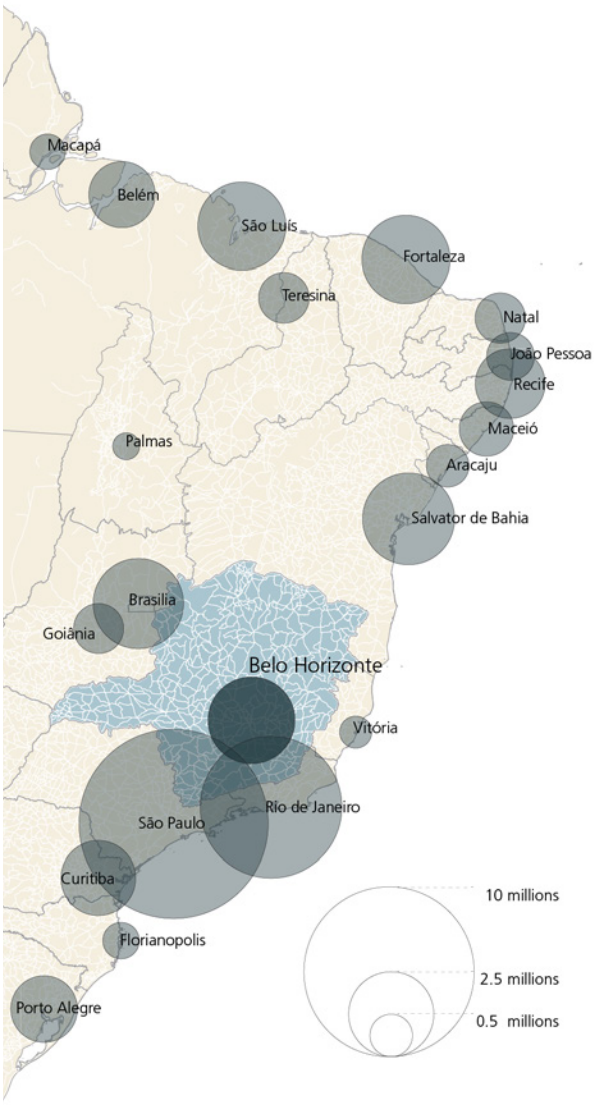


Fig. 2. Minas Gerais and Brazil State Capitals by population

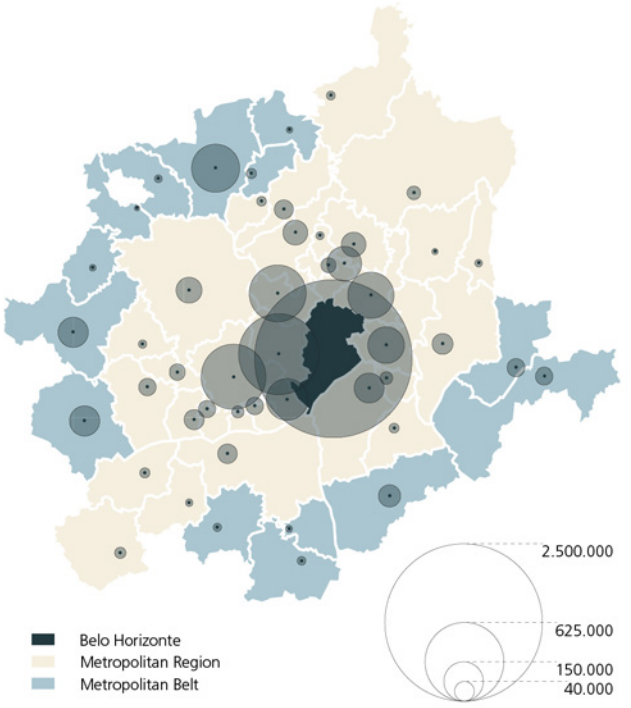


Fig. 3. Belo Horizonte Metropolitan region and its towns by population

Fig. 4. Belo Horizonte aerial view (Source: Prefeitura de Belo Horizonte)

PROBLEM STATEMENT

Initial analyses and consultations with a wide range of state and city level stakeholders highlighted that the gaps in Belo Horizonte's mobility system are some of the most pressing needs for the city to safeguard its long-term future.

The city has already promoted significant public transport infrastructural investments. The municipality of Belo Horizonte was the first in Brazil to enact an Urban Mobility Plan (PlanMob-BH) in 2013. A high standard bus rapid transit system (MOVE) was implemented and bus-only lanes for the normal bus service were created throughout the city. The downtown has been revitalized with pedestrian-only streets and a new focus on mixed-use, transit-oriented developments (TOD). Though the city is hilly, a city-wide cycling network is planned, with 90 kilometres of protected bike lanes already built. An effective and relatively economical measure that brought significant improvements to the mobility of Belo Horizonte, PlanMob-BH has been praised and imitated and contributed to the city's competitiveness on the regional scene.

However, the public transport strategy of Belo Horizonte is starting to struggle to cope with the fast pace of the developing trends of the city. Despite the efforts on developing public transport, car ownership rates are constantly increasing and seriously compromising the city's ability to improve its mobility situation. Problems of urban congestion and stress put at risk Belo Horizonte's competitive advantage, impacting businesses and citizens in the form of higher costs, wasted time and reduced accessibility. Dependence on fossil fuels and high levels of pollution and greenhouse gas (GHG) emissions affect human and ecosystem health and the climate system.

INTELLIGENT MOBILITY IN EXPRESSO AMAZONAS

Focusing on mobility will help to deliver much-needed jobs, provide environmental stewardship and address social imbalances which, in turn, are key to the Municipality's success in terms of liveability, prosperity and resilience.

The city's mobility plans are ambitious and the implementation rate of PlabMob-BH has struggled to meet the provisions.[3] Whilst the expansion of the physical transport infrastructure is essential to cope with the current trends and risks, innovation is a soft intervention that does require investments in Research & Development, capacity training and network infrastructure, but can be undertaken today to enhance the use of what already exists and improve the transport system to manage long-term expansions.

Investing in the ability to identify and develop new technologies and processes is a fundamental pathway to the success of organisations managing urban sustainability.

A limited amount of BRT stations in Belo Horizonte are already experimenting with the use of sensors to capture large cohorts of data in order to optimise timetabling of bus services. A more comprehensive and structured use of technologies could enable wide-ranging service improvements.

Intelligent systems allow transport modes to communicate with each other and with the wider environment, paving the way for truly integrated transport solutions and experiences. This will facilitate multimodal journey selection, including walking and cycling options, and result in improved options for public and active mobility.

The main objective of the proposed intervention is the feasibility study for the adoption and optimization of a technology to support a more efficient transportation and mobility management system while, at the same time, encouraging public transport as the main mode of transportation. Specifically, the new technology would support supervision and counting of passenger movements in the public transport vehicles, including boarding and alighting at the stations.

Such a technology could make a positive contribution to mobility, accessibility and equality in an urban area, helping to:

- Improve the operation of the system (punctuality and regularity of bus service in real time, travel time)
- Monitor bus occupancy to optimize routes
- Communicate information to users related to the operational status of the bus network
- Improve and analyse customer feedback
- Improve transportation and mobility planning
- Provide solutions for enabling network integration and multimodal transportation options

To narrow the geographical scope, the intervention aims at the integration of the proposed Intelligent Mobility System within the Amazonas Corridor, the main transport corridor of the metropolitan region, in the South-West part of the municipality.

The corridor is the object of many project proposals for expanding and optimising its capacity. However, one of the main challenges is to optimise the public transport service: currently Avenida Amazonas, the principal route of the corridor, has the highest volume of buses in Belo Horizonte. The adoption of a technology that indicates how passengers travel would improve transport planning for the Amazonas Corridor. In the short- and mid-term it would help to optimise the system and offer bus services according to the demand. The improvement in transport planning would impact the permeability and connectivity of the public transport system, creating savings for the users' social inclusion, a reduction in travel time and shorter waiting times.

Specific components of the Intervention are:

- Baseline Assessment to contextualise the capacity of Belo Horizonte to implement an Intelligent Mobility Solution (IMS) and set goals to be achieved with the intervention
- Mapping and evaluating technological alternatives for the Intelligent Mobility In the Expresso Amazonas (IMEA)
- Viability Assessment to recommend an Intelligent Mobility System (IMS) for the Expresso Amazonas, including Pilot monitoring and evaluation of technologies alternatives
- Implementation
  1. Help key stakeholders to build capacity and enable the sustainability of the intervention
  2. Support the implementation of data architecture and analytics
  3. Provide a strategy to scale up intelligent mobility system to entire system of Belo Horizonte

Main Stakeholder

BH Trans - Transport and Transit Company of the Municipality of Belo Horizonte

Possible Project Partners

- PRODABEL – Information Company of the Municipality of Belo Horizonte
- COP-BH – Centre of Operations in BH
- Sub-secretariat for Modernization of Management
- Municipal Secretariat of Urban Policy
- Secretariat of Infrastructure and Public Works
- CEFET - The Federal Center for Technological Education of Minas Gerais
- SETRA BH - Union of bus operators of BH

Thematic Cluster
Data systems for multi-modal mobility

Keywords
Data integration, data analytics, public transport, smart mobility, connectivity

URBAN ANALYSIS

Spatial Analysis

EXISTING CONDITION OF THE MOBILITY SYSTEM

Belo Horizonte's mobility system comprises a complex network of state and municipal roads, public transport means, including a metro, BRT, conventional buses and complementary transport services, as well as a growing cycling network.

The public transport network is composed of various services that, although not managed by the same operator, comply with schedules, itineraries and tariffs established by BHTRANS, the Transport and Transit Company of the Municipality of Belo Horizonte. The PlanMob-BH 2030 horizon sets improvement aims for the public transport network, which the city has been steadily working towards but which may nonetheless prove to be rather ambitious.

Road Network

The road network of Belo Horizonte serves not only the urban municipality but also the wider federal and state network. The main road axis in Belo Horizonte is the Rodovia Celso Mello Azevedo (henceforth referred to as the ring road), which was built in the 1950s. It attracts both a significant volume of urban as well as medium- and long-distance traffic, which compromises its capacity. Furthermore, despite being an integral part of the urban road network, the ring road lacks adequate connection to urban transport corridors. The PlanMob-BH 2030 horizon proposes the construction of a new bypass between two metropolitan cities, Betim and Sabará, to divert strategic traffic away from the urban area of Belo Horizonte, consequently freeing up capacity on the ring road for urban travel.

High and Medium Capacity System - Metro and BRT

The Belo Horizonte Metro currently only consists of Line 1, which connects Eldorado in the west to the city centre and the Venda Nova neighbourhood in the north of Belo Horizonte. Line 1 is 28.1km long, stops at 19 stations and transports an average of 230,000 passengers per weekday. It is managed by the Companhia Brasileira de Trens Urbanos (CBTU). A total of 23km of the MOVE system was installed in 2014, connecting the northern region to the central area through two main corridors. In addition to the MOVE, exclusive tracks of collective transportation were implemented, promoting the connection of Vector Norte with other important transportation corridors and regions of the city. The Metro and BRT lines align with desire lines as can be broadly derived from the latest (2012) Origin Destination study, which reveals that a large number of trips originate in Contagem in the west and Santa Luzia in the north.[4]

Conventional Buses

In addition to the above public transport, a conventional bus network comprising nearly 300 lines serves a variety of distinct purposes. The operation of the lines is divided geographically among four consortia. Three types of services can be classified: trunk and feeder services, which serve the main axis by feeding the high- and medium-capacity lines and distributing passengers from the main transport terminals to other metropolitan centres and local regions; inter-district services, which connect neighbourhoods to the city centre and other districts and, finally, district services, which provide a circular connection between different areas.

Complementary Network

The complementary network is composed by low capacity transport services, referring to the lines of the vilas e favelas for informal settlements and the supplementary services. The former serves low-income and informal areas with smaller vehicles, so called microbuses, suitable for the topographic conditions and limitations of the road system. The latter uses slightly larger minibuses to link peripheral neighbourhoods but are banned from operating in the central area of the capital, bound by Avenida do Contorno. The complementary network is a system of autonomous operators who, nevertheless, comply with schedules, itineraries and tariffs established by BHTRANS.

Active Mobility (Non-Motorized Transport)

In 2005, Belo Horizonte instituted a specific programme for the use of bicycles, called the Pedala BH. The purpose of this programme is to promote and facilitate cycling as a mode of transport. By 2030, the city aims to have constructed a cycle network of 411 km. By 2014, 70.42 km of cycle paths had been built and 22.17 km were under construction.[5]

Fig. 5. Main transport corridors in Belo Horizonte

UNSUSTAINABLE TRENDS

The complex transport system of the city and the ambitious strategic masterplan (PlanMob-BH 2030) demonstrate a strong commitment of the public administration to guarantee an efficient service. Nevertheless, the general conditions of the mobility system present several issues and the future trends point to the necessity of an alternative and innovative solutions.

Traffic Congestion

Traffic congestion, particularly during peak hours, is one of the most pressing issues in the Municipality of Belo Horizonte. According to surveys, city inhabitants perceive congestion to be one of the most urgent problems and greatest inconveniences due to its direct negative impact on daily activities.

In the morning peak the congestion level (the increase in overall travel time compared to free-flowing traffic) reaches 42 per cent. In the afternoon peak congestion levels rise even higher, reaching 59 per cent. Consequentially, increased journey times, higher possibilities of accidents and progressively-deteriorating air quality are highly likely to have a negative effect on life quality, productivity, health and the environment. Likely causes of congestion are the inability of the public transport system to satisfy customer demand, coupled with growing private vehicle ownership in the region.[6]

Private Traffic Growth

A further issue linked to congestion is the growing motorization rate (private car and motorcycle) ownership and private transport use at the expense of the public transport system. The latest mode share analysis from 2012 showed that 43 per cent of trips are made by car or motorcycle and that this is expected to increase to 45 per cent by 2030. Whilst the mode share of active mobility is expected to increase slightly to 37 per cent, public transport is predicted to decrease to 18 per cent.

This growth is one of the key factors likely to be causing this modal shift away from public transport. As shown in the tables in this page, the motorisation rate in Belo Horizonte and RMBH has rapidly increased, particularly in recent years, with no correlation to population growth rates. In absolute terms, the number of registered vehicles in Belo Horizonte grew from approximately 750,000 in 2002 to 1.6 million in 2014.

It should be noted that similar growth rates are also prevalent in other developed and industrialised Brazilian states due to credit expansions, public incentives for

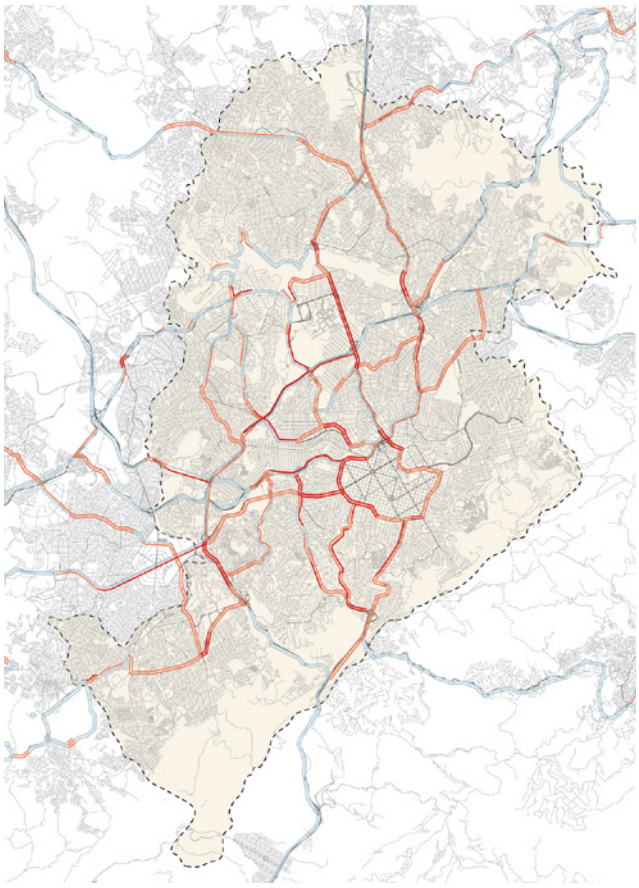
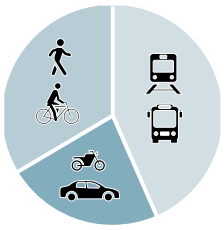


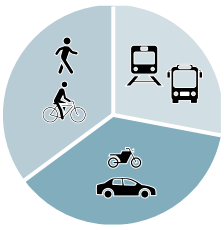
Fig. 6. Traffic in Belo Horizonte (Source: Google Map)



TRANSPORT MODES

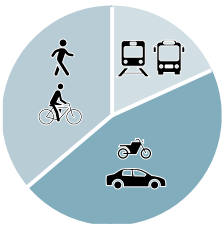
2002

Pedestrian and cycle:	**34%**
Public transport:	**43%**
Private transport:	**23%**



2012

Pedestrian and cycle:	**34%**
Public transport:	**43%**
Private transport:	**23%**



2030 - FORECAST

Pedestrian and cycle:	**37%**
Public transport:	**18%**
Private transport:	**45%**

Fig. 7. Transport mode use (Source: Relatorio sintesi - Planmob BH)

purchasing cars and the rising income of the middle class that has characterized Brazilian urban society in recent decades.

Environmental Impact

Over recent decades greenhouse gas (GHG) emissions in the municipality of Belo Horizonte have grown progressively. Data collected between 2000 and 2013 shows an increase in emissions from 2.59 million to 4.40 million tCO2e and projections indicate the risk of GHG emissions reaching 6 million tons per year in 2030 if no drastic change is made in the mobility modes.[7]

Transport or so-called mobile sources such as road and air traffic contributed to more than 71% of the GHG emissions, according to the most recent analysis from 2013. Stationary sources, which means different types of buildings, and waste treatment were responsible for 18.4 per cent and 10.6 per cent respectively.[8]

The municipality of Belo Horizonte acknowledges the importance of the transport sector in reducing GHG emissions and has committed to reducing them by 20 per cent by the year 2030 in relation to the base year 2007.[9] In order to achieve this goal the municipality developed the Municipal Greenhouse Gas Emission Reduction Plan (PREGEE), which comprises a set of mitigation strategies in the areas of mobility, sanitation and energy efficiency. The Plan also addresses adaptation measures.

Accident Analysis

The municipality of Belo Horizonte has been committed to the reduction of accidents and the measures adopted have generally proven to be effective. In 1997, with the promulgation of the new Brazilian Traffic Code, the municipality implemented a traffic control system based on electronic speed surveillance. In 2011, the municipality joined the Ministry of Health's Program for Life in Transit (PVT), within the guidelines of the UN Decade of Traffic Safety Actions 2011-2020, which aims to globally reduce fatal accidents by 50 per cent by 2020.[10]

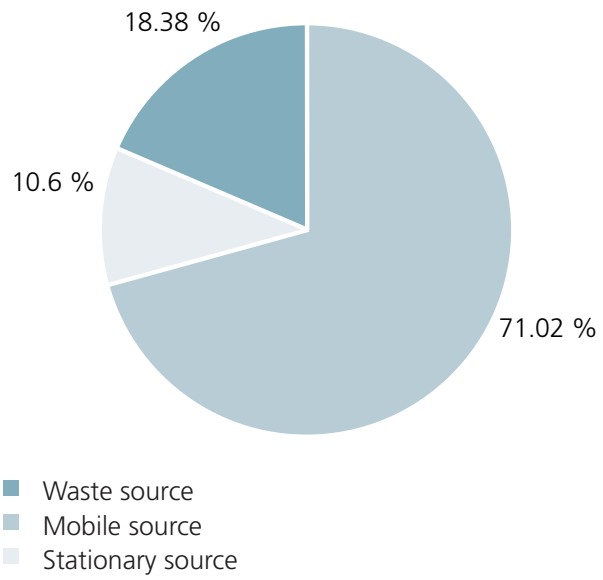


Fig. 8. Emission of Greenhouse Gases , by sector, 2013 (%) (Source: ICLEI Case study - No. 185, Belo Horizonte, Brasil, 2016)

Figure 9 shows that the municipality has been able to successfully reduce accident rates, particularly when compared with the rapid growth of the number of vehicles in the city. The number of deaths and injuries remained consistent and is one of the municipality's primary concerns. According to the accident records of the municipality of Belo Horizonte, in 2014, there were 14,965 personal injury road traffic accidents which caused a total of 18,300 non-fatal injuries and 177 fatalities.[11]

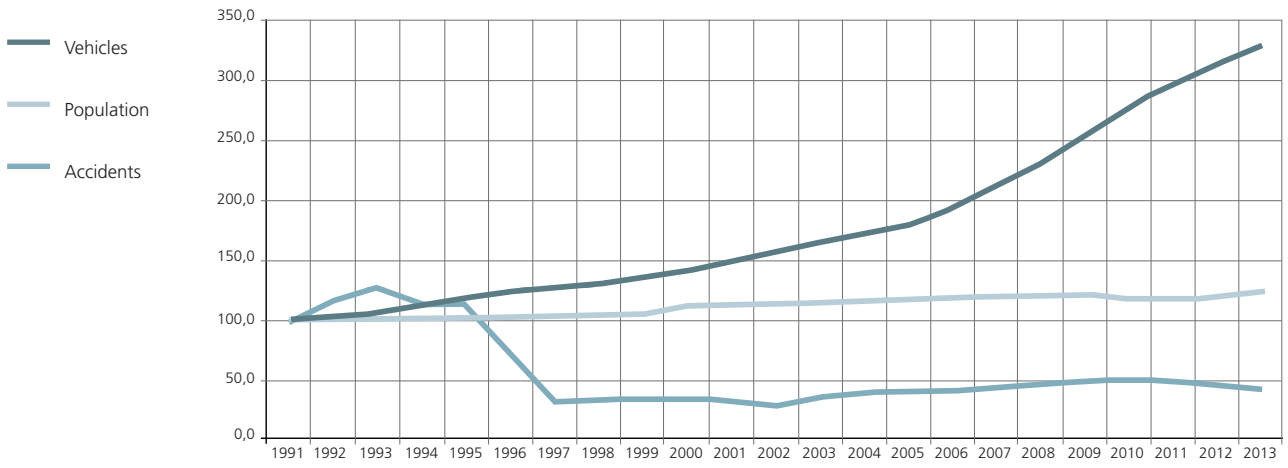


Fig. 9. Number of vehicles, population and accidents growth. (Source: Belo Horizonte - DETRAN/MG; População – IBGE; Dada elaboration: GEPIN/BHTRANS)

Fig. 10. COP-BH - Belo Horizonte Integrated Operational Centre (Source: pordentrodeminas.com.br)

The increasing number of private vehicles and in particular motorcycles is one of the main factors inhibiting the further reduction of the number of accidents in the city, despite good policies and measures adopted.

BH DATA INFRASTRUCTURE

Data Collection And Analysis By BHTrans

Approximately 80 per cent of public transport users use a transport card, rechargeable in the main stations/nodes. Alternatively, passengers can buy the ticket from the driver while boarding, or from ticket offices in the main stations. Because of safety reasons the drivers cannot provide change at night and it is often true that some users are not able to buy a ticket. The use of a ticket app is not yet a reality because of reduced mobile internet access throughout the population. Some stations are already equipped with wi-fi connection as a result of a pilot project.

BHTRANS is implementing its Intelligent Collective Transport System (*Sistema Inteligente de Transporte Coletivo - SitBus*). More than 1000 cameras and sensors have been installed and they are monitoring traffic, numbers of vehicles and numbers of people at bus stops. Some sensors are only used for safety purposes. All buses have a GPS system and on-board cameras, which inform electronic panels at stations, and a dedicated app about real time schedules. A limited number of BRT stations in Belo Horizonte is already experimenting with the use of sensors to count passengers, to optimise the timetabling of bus services.

BHTRANS would like to expand the number of cameras and sensors and develop in more detail strategic studies related to users. Normally the only surveys they do are related to passengers' age and disability. They have some pilot projects related to blindness (an app that reports to the user when the bus is approaching the bus stop) and women's vulnerability since the majority of bus users are black working women.

Thanks to these systems BHTRANS have a considerable amount of raw data collected from the bus network but among their 1000 employees are just two data analysts. This could constitute a significant constraint to progress.

Questions of data governance should be addressed to refine processes, methods, tools and techniques to ensure that data is of high quality, reliable and unique (not duplicated) so that downstream uses in reports and databases are more trusted and accurate. This would allow integrated data management to support city management, both inside the municipality and with companies and universities

Interdepartmental Integration

Belo Horizonte has an Integrated Operational Centre (Centro de Integrado de Operações de Belo Horizonte - COP-BH) gathering together all entities that support the city operations: police force, civil protection, fire protection, traffic, energy company, water and sewage company, municipality and the state government among others. All these institutions are based in the same room with access to all the cameras, sensors and emergency

services in the city. The idea of this centre is to integrate all the city institutions, so they can support and respond better to emergencies as well as better plan city events.

This centre was envisioned as a facilitator for integrated actions and decision making beyond present events, to support the municipality to define policies, decisions and interventions that at the present are often not based on evidence. However, this only can happen with an improvement in their systems, with a modernisation of technology as well as qualification of human resources.

Smart City Initiatives

Belo Horizonte has already the highest density of IT enterprises in Brazil and, in San Pedro Valley, one of the biggest start-up communities. PRODABEL, the IT company of the municipality (Empresa de Informática e Informação do Município de Belo Horizonte) is a laboratory for technological development. This is a certified open facility to the industry, allowing companies to test solutions and do trials and pilot projects in Belo Horizonte.

The biggest challenge is to boost regional potential and skills to retain incubated companies as the proximity to Rio de Janeiro and Sao Paulo makes it hard to keep the companies in Belo Horizonte for a long period of time. It is common that the companies are incubated in Belo Horizonte and they later move to Rio and Sao Paulo where they find more business opportunities and support.

BH Cidade Inteligente (Smart City) is a strategic programme that aims at consolidating the city as a centre for smart technologies applied to urban solutions and sustainability. The programme wants to use the Smart City approach to meet the challenges of municipal management. However, the municipality also aims at interacting with the city's technological ecosystem to build joint solutions and encourage technology-based companies to consolidate the ICT sector as a city brand and foster economic development and job creation.
Data transparency and open data was identified as one of the ways to motivate and support this change. The priority sectors are health services and biotechnology, IT and the green economy. Transportation is included in the green economy area and the municipality is trying to support some of the interventions but many areas and projects have not progressed because of the lack of funds.

AMAZONAS CORRIDOR

The unsustainable nature of the trends analysed above confirms the necessity to invest and design new strategies for the improvement of the public transport system. Inverting the growing reliance on private transport ought to be one of the main priorities of the city in order to achieve a high quality of life, and socially- and environmentally-sustainable urban development.

Fig. 11. Avenida Amazonas (Source: Bernardo Gouvêa ©)

Mobility In The Amazonas Corridor

The Amazonas Corridor represents one of the most important axes for the city of Belo Horizonte. It counts the highest number of commuters in the city with the operation of 36 municipal bus lines that attract 5.803 trips/day (46.2 per cent) and 86 metropolitan lines that attract 6,757 trips/day (53.8 per cent).

The total number of passengers per day for the municipal lines of the corridor is 423.656, or 30 per cent of the total number of passengers using the municipal system. The metropolitan serves 415,280 passenger per day, which is 44 per cent of all passengers using the inter-municipal system.

The public transport service operates on reserved lanes along Avenida Amazonas but suffers from interference by the general traffic, mainly due to the large number of lines, and the unsuitable layout of bus stops, crossings and turning points. At peak times, vehicle speed reaches 13 km/h, compromising the attractiveness of the public transport system.

Private traffic amounts to 65,000 vehicle trips per day passing the Avenida Amazonas, steadily growing over the past decade. It is the main cause of the increase in the average travel time from 38 minutes in 2002

to 60 minutes in 2012. In 2016 alone, 443 accidents were recorded on this road and this resulted in several fatalities and contributed to traffic congestion.

Low-income Neighbourhoods

The importance of this corridor for the city stems first and foremost from the strategic role it plays in connecting the regions of Barreiro and Oeste and the municipalities of Betim and Contagem to the city centre, where most of the formal jobs are located.

The south-west areas of BH are defined by the lowest Human Development Index (HDI) in the city, with both formal and informal low-income neighbourhoods.

The residents of these areas represent the main users of public transport and they are the most affected by the system's inefficiency and lack of accessibility. This issue represents a challenge at the municipal scale as approximately 20 per cent of citizens live in informal settlements, public social housing or on irregular land subdivisions.

Potential Synergies With Other Projects

In previous years several considerations – the proximity to the existing metro line to the Amazonas Corridor, the necessary improvement of the connection to the stadium and the airport for the 2014 FIFA World Cup among others – has forced the city to prioritize the mobility of the northern area in the previous years.

However, given the strategic importance of the corridor for Belo Horizonte and the entire metropolitan region, the municipality is planning several interventions in the area.

In 2017 Belo Horizonte promoted an innovative project called the Mobility and Urban Inclusion Programme in Belo Horizonte with the aim of integrating urban mobility and transport planning with the upgrade of formal and informal low-income settlements.

The project strategy focuses on two key interventions:

- The optimization and integration of the transport system along the Amazonas Corridor, the so-called Expresso Amazonas
- The urban renewal of an informal settlement called Vila Viva Cabana do Pai Tomas through the improvement of the infrastructure system, the upgrade and creation of public spaces and the development of social housing units for resettlement

AMAZONAS CORRIDOR TRAFFIC

65.000 vehicles/day

MUNICIPAL SERVICE

36 bus lines

5.803 trips/day

423.656 passengers/day

METROPOLITAN SERVICE

86 metropolitan lines

6.757 trips/day

415.280 passengers/day

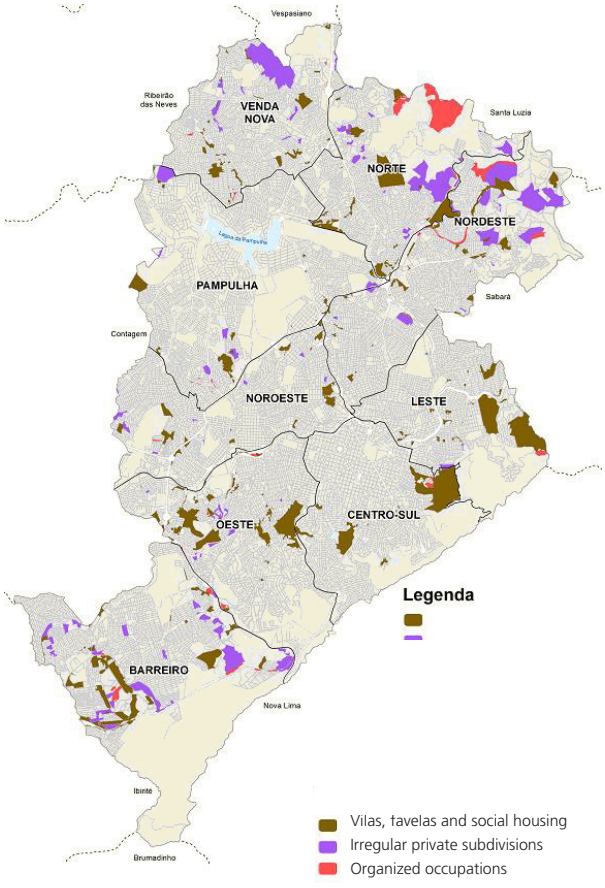


Fig. 12. Low income neighbourhood (Source: Carta consulta - Belo Horizonte)

The project is currently under negotiation for finance with the World Bank but the Municipality has already allocated a budget to cover part of it. Such an initiative is in alignment with the GFCP proposed intervention and could amplify significantly its transformative potential.

Main Objectives Of The Mobility And Urban Inclusion Programme

- Reduce travel time and increase public transport speed (+20 per cent)
- Improve boarding and alighting
- Promote an accessible and safe service for all
- Improve environmental quality through the reduction of greenhouse gas emissions, local air pollution and noise pollution
- Increase and promote the use of public transport

Cross-cutting Issues And Innovation

- Promote gender equality and women's empowerment initiatives
- Promote projects and investment focused on pedestrian and cycling mobility
- Promote and invest in innovative technologies to work on topics related to gender, safety, community participation and open data
- Improve origin and destination surveys through the optimisation of the system and the reduction of survey costs and time and increase the survey frequency

Mobility Project Proposal

- 43 km of priority lanes for public transport means
- Implement the Salgado Filho Integrated station (design and realisation)
- Prioritise and support the public transport system through electronic control against lane invasion
- Revise and improve the intersection of Avenida Amazonas with the ring road to reduce delays
- Improve safety along the corridor with:
- signalised pedestrian crossings
- measures access for people with disabilities
- electronic speed control
- traffic light synchronisation

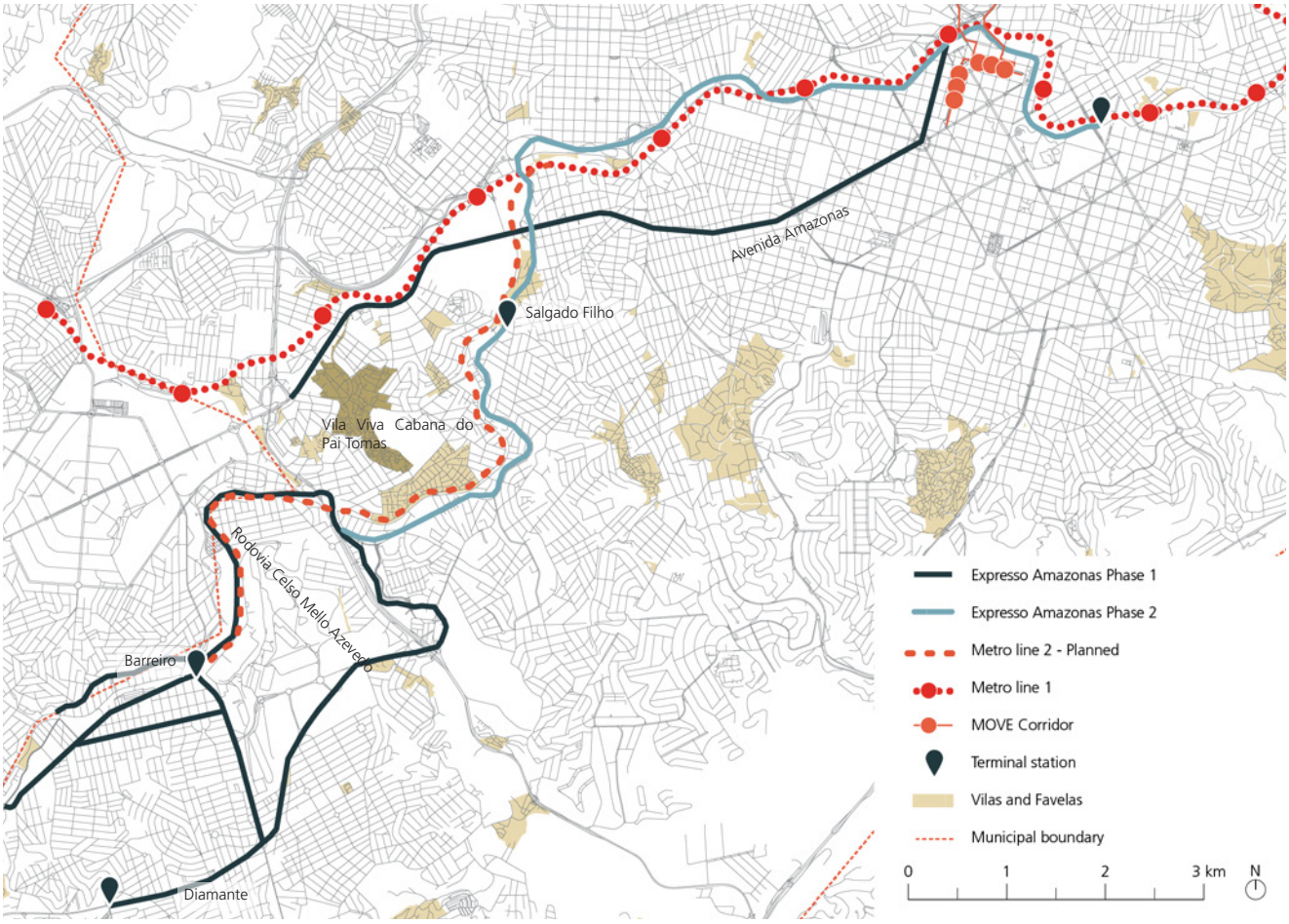


Fig. 13. Expresso Amazonas (Source: Carta consulta_Belo Horizonte)

Financial Analysis

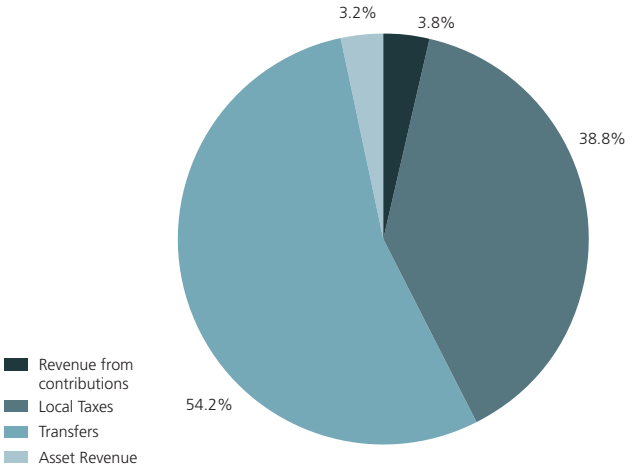


Fig. 14. 2017 Source of Municipal Revenue

FINANCIAL CAPACITY

The Municipality of Belo Horizonte has significant financial capacity, both in terms of total revenues and access to finance. Belo Horizonte is also increasingly prioritising spending on transport, which makes the city well placed to maintain investments in data systems over time as well as related investments in the transport sector.

The Municipality of Belo Horizonte had a budget of roughly 2.4 billion USD in 2017, and this is projected to continue to expand. This translates into a budget per capita of approximately 1000 USD, which is high compared to other cities of the GFCP of similar income, such as Johannesburg (740 USD) and Ankara (164 USD).

In 2017, Municipal spending stood at 9 billion Brazilian Real (BRL). By the end of 2018 it is expected that Municipal spending will have risen to around 12.5 billion BRL (roughly equivalent to 3.2 billion USD). The majority of these revenues come from transfers from the central government, comprising about 53.74 per cent of the total in 2017, while local taxes make up around 38.5 per cent of the revenue (as of 2017). Figure 15 provides further detail on the sources of revenue in 2017 as well as the breakdown of the projected spending for 2018.[12] As can be seen, revenue from contributions and assets comprise the remaining 7 per cent of municipal revenues in 2017 and transport and urban related investments together comprise roughly 10 per cent of total projected spending for 2018.

It is important to note that the Municipality of Belo Horizonte does relatively well in raising local taxes compared to other Brazilian municipalities. As of 2017, local taxes made up 38.5 per cent of total revenues, mainly from property taxes, whereas, the average Brazilian municipality only generates an average of 6 per cent of its budget from local taxes.[13] There are two key local taxes that Belo Horizonte over which has

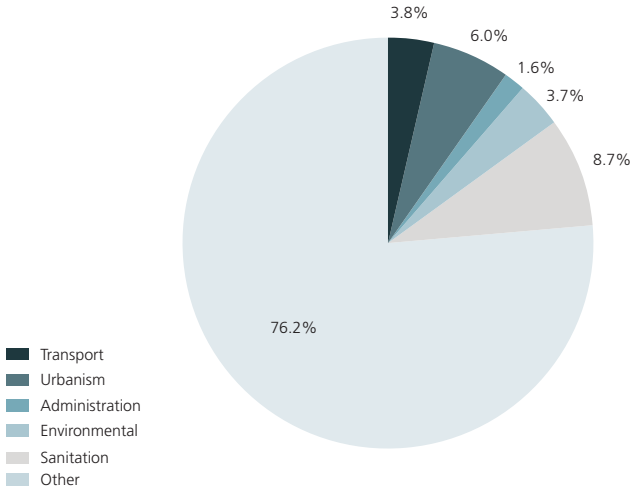


Fig. 15. 2018 Projected Spending

exclusive power: the Urban Property Tax (IPTU) and a tax on real estate transfers (ITBI). Both of these capture land values and are able to generate significant revenue. As shown in Figure 16 below, data from 2008 reveals that Belo Horizonte had the fifth-highest Urban Property per capita tax collection among capital cities in Brazil. This relatively strong performance suggests that there is further potential for the city to expand local taxes in order to better capture land value, which will be particularly valuable in capturing returns from transport investments.

City	IPTU per capita (BRL)
São Paulo	265.1
Florianopolis	223.6
Rio de Janerio	193.6
Porto Alegre	169.7
Belo Horizonte	164

Fig. 16. Property per capita tax collection among capital cities in Brazil

FINANCIAL COMMITTMENTS TO IMPROVING URBAN MOBILITY

The Municipality of Belo Horizonte has shown an increased financial commitment to urban mobility and, in particular, collective modes of public transportation. The bar chart in Figure 17 below shows the projected expansion of spending on transport by the Municipality of Belo Horizonte between 2018 and 2020. The 34 per cent projected increase in transport spending clearly indicates a strong willingness to develop better capacity in the city to undertake comprehensive urban mobility projects, and could make an intervention targeted at collective (shared) public mobility systems more sustainable. Furthermore, according to the 2030 Belo Horizonte Mobility Plan, the city estimates that about 50 per cent of the transport budget by 2020 would go into investments in collective mobility systems, of which 87 per cent are costs for the implementation of new subway lines.[14] However, it should be caveated that the capital investment required for new subways lines would likely demand federal government support and there is currently no certainty that it would happen.

ACCESS TO FINANCE

The Municipality of Belo Horizonte has access to other sources of credit but in some cases this is subject to federal restrictions. On the lending front, the municipality is perceived to be creditworthy, as suggested by a recent loan from the World Bank in 2013 for 200 million USD.[15] Building on this, there should be potential for any further 'hard' interventions to both explore loans from multilateral lenders as well local and regional lenders such as the Brazilian National Bank for Economic and Social Development (BNDES), and Latin American banks such as the Development Bank of Latin America (CAF). However, it is important to note that under the Federal Law of Fiscal Responsibility, there is a legal debt ceiling on municipalities.[16] Local public lenders such as BNDES also usually have specific constraints which require them to allocate credit by type of investment such as housing or education.[17]

If the intervention involves the use of a Public Private Partnership (PPP) or recommends the use of a PPP as a financing arrangement, the Municipality of Belo Horizonte has the legal authority and precedent to enter into them. In some cases, PPPs can help to finance large expenditures such as a public transport investment. For example, the state of Minas Gerais in which Belo Horizonte is located, is in the process of entering into a PPP for solid waste management for the city and its surrounding metropolitan region. It is, however, unclear the exact role the Municipality of Belo Horizonte has in this agreement.[18]

Under Federal Law (8666/93), there are detailed and uniform procedures for procurement that should be adhered to by all layers of government, including the municipal entities. In most municipalities, there are internal control entities which are nominated by the municipalities themselves to oversee the public procurement procedure. However, particularly in Belo Horizonte, there have been concerns about the capacity for the municipality to undertake large procurement efficiently.[19]

Fig. 17. Transport vs Total Projected Local Spending (2018/2020, values in BRL)

Legal Analysis

LEGAL FRAMEWORK FOR DATA USE

Open Data

There is evidence of existing political will and complementary legislation to facilitate open data in the Municipality of Belo Horizonte. Most notably, the Municipal Decree No. 14,906 /2012 ensures the public have access to data that is collected by various departments and affiliated bodies within the Municipal Government.

An example of this in the transport sector can be seen through BHTrans, the organisation that manages most of the functional public transport in the municipality, as they are mandated to collect and publish data on traffic operations and traffic accidents in the city.

Similarly, the Secretariat for Urban Regulation, which is part of the Department of Urban Policy, publishes data related to the urban regularity of properties in the city.

The online management and maintenance of data across the municipality falls under the jurisdiction of the IT company PRODABEL and it is likely that this data could be effectively leveraged to make evidence-based transport policy decisions.

Data Standardization And Sharing

In general, there is a lack of coordination and standardisation of data across the various municipal agencies, and this may prevent opportunities where the intervention could provide assistance. Each agency within the Municipality of Belo Horizonte collects its own data but it is often only used by the agency that collects it, as there is no comprehensive framework, legal or otherwise, for standardisation and sharing which could permit other agencies and sectors to use the data to facilitate more effective and longer-term transport planning.

For example, on the SITBus system BHTrans has been able to use mobile data platforms to allow passengers to find their fastest routes via public transport and have also collected data on when commuters enter and exit the bus system. However, these schemes are yet to be rolled out throughout the entire MOVE BRT network; moreover, there are no formalised plans to use the newly-collected commuter behaviour data for other parts of urban planning. This may be in part because there is no centralised authority set up to use the data collected by different agencies and integrate them in a way such that they could be used in broader city planning - akin to a data analytics lab. This contributes to difficulties in coordinating transport policies and integrating transport with land-use planning. Hence, a potential intervention which focuses on standardisation, integration and robust use of data in policymaking could have a significant impact.

Data Privacy

Until recently, there has been no specific law in place concerning the protection of personal data in Brazil.[20] While there were sector-specific laws which cover particular parts of the protection of data, there was no single law which covers the protection of personal data generally. The proposed Bills 5276/2016 and Bill 330/2013 were expected to act as general data protection laws[21], and propose a supervisory authority which would use transparent means for the use and sharing of anonymized data, meaning that, although not explicit in the laws, this anonymised data could theoretically be used for policymaking.[22]

On August 14, 2018, Brazil approved the General Data Protection Law to establish a unified legal framework for data usage across the country. The law has 'transversal, multi-sectoral application to all sectors of the economy'.[23]

EXISTING POLICIES FOR MOBILITY, TRANSPORT AND SMART CITY INFRASTRUCTURE

Mobility And Transport

There is a clear commitment from the Municipality of Belo Horizonte to invest in collective mobility, as shown by their implementation of the city's first BRT system in 2014. This strong commitment is outlined in The 2020 Belo Horizonte Mobility Plan (PlanMob-BH 2030) adopted in 2013 as part of the Municipal Decree No. 15,317. The Plan itself aims to improve the public transport network of Belo Horizonte and this fits in closely with components of the city's overall Strategic Plan ('BH 2030'), which not only aims to increase public transport usage from 43.3 per cent (2012) to 70 per cent of all motorised trips in the city by 2030, but also

involves measures such as reducing poverty from 3.8 per cent in 2010 to 1.9 per cent by 2030 and making sanitation accessible to all.

Improvements to the mobility system of BH also align quite strategically with other policies in place for the city, notably the Municipal Greenhouse Gas Emission Reduction Plan (PREGEE), the Mobility and Urban Inclusion Program to integrate informal settlements into the urban fabric, and the Program for Life in Transit (PVT) to reduce traffic-related accidents. Similarly, an urban mobility plan is also in development for the entire metropolitan region (RMBH); currently in the diagnosis phase, it is likely that this plan could contribute to improved urban mobility in both BH and RMBH.

For its commitments to collective mobility, the Sustainable Transport Award Committee gave its 10th Annual Prize to Belo Horizonte (along with Rio de Janeiro and São Paulo).[24] Future transport policies may wish to reflect the need to coordinate and integrate various transport policies and departments and it is unlikely that the proposed intervention will conflict with existing and expected future policies. The fact that the Belo Horizonte Mobility Observatory (ObsMob-BH) was established as part of PlanMob-BH 2030 with the role of monitoring and coordinating various stakeholders in the transport sector reflects the fact that coordination and integration are key elements of the aims to achieve mobility objectives.

Smart City

As mentioned above, the Belo Horizonte Cidade Inteligente (Smart City) is also a strategic programme of the Municipality of Belo Horizonte to evolve its technological infrastructure and foster its ICT sector as a brand of the city.

There is some commitment by the national government to encouraging municipalities to conduct research, including on the potential of the smart usage of data. Launched in 2014, the Programa Nacional de Plataformas do Conhecimento (National Programme for Knowledge Platforms) is aimed at funding research on various fronts, including that on smart cities. The program commits 20 billion BRL (about 5 billion USD) in grants to this end and this could theoretically include investments in smart data for transport.[25]

INTERNATIONAL ALIGNMENT AND TECHNICAL RECOMMENDATIONS

Potential Impact

The potential impact analysis outlines the main benefits that can be potentially attained through the Global Future Cities Programme in each city, under three moments: short, medium and long term. Nevertheless, as impact can arise from a complex interaction of context-specific factors, rather than as result of a single action, an empiric impact assessment is out of the scope of this report.

The short-term refers to the outcomes that can be achieved through the implementation of the technical assistance support within the 2-3 years' scope of the Global Future Cities Programme. Mid-term outcomes are only achievable once the intervention is executed at the city level either through capital investments or the legal validation of key polices and plans. Long-term impact of the interventions is linked to the sustainability of the interventions in a 7-15 year timeframe and is related to the project cycle phase of operation and maintained.

SHORT-TERM OUTCOME

Data plays a critical role in how evidence-based decisions are made and how evidence-based policies, strategies, plans and implementation programmes are developed. Better data availability and analysis capacity on the main transport corridor of BH will bring increased capacity to prioritize strategies and tools for decision-making based on informed statistics and other holistic projections.

At the same time, the capacity-building component of the intervention will contribute to reaching the level of maturity of human resources within the Municipality of Belo Horizonte to work and sustain intelligent mobility technologies. It will provide the necessary tools for evaluating and monitoring the impact of urban plans, policies and strategies within the local administration.

This increased availability of data and increased evidence-based decision-making capacity will also improve the ability to plan economic growth in an inclusive and sustainable way. It will improve accessibility to employment and promote innovative professional opportunities while also enabling a reduction of time and resources toward an efficient and environmentally-safe urban development.

MEDIUM-TERM OUTCOME

Improving the monitoring and the management of the public transport network, the intervention would improve the efficiency of the transport system and allow the delivery of a more convenient and reliable public transport and better integration of transport modes.

Improving the connection among transport modes (regular services and vilas e favelas systems), and between transit stops and key destinations along the Amazonas Corridor could also trigger a better offer of safe, comfortable and convenient options for transit service.

The availability of quality, accessible, timely and reliable data disaggregated by income, sex, age, ethnicity, disability and geographic location could be reflected in the planning and delivery of a public transport options that can target the needs of informal settlement, as well as women, elders and vulnerable groups. In the middle-term, this could contribute to increased access to public transport for low-income communities in the catchment area of the Expresso Amazonas (Vila Viva and Cabana Do Pai Tomas). It could also help in improving safety and security of stations and buses, especially for women and elders.

Therefore, in the mid-term, the city could experience an increased use of public transport especially by woman, the elderly, youth and people with disabilities. Better connectivity can also improve the life condition of the low-income communities around the Expresso Amazonas, thanks to access to jobs and services.

Finally, by including methods to account for user experiences in the measurement of the service, citizens' participation can be increased, while embedding gender equality approaches and target vulnerable groups. This will enhance the ability of the municipality both in the elaboration of inclusive and more sustainable plans and strategies and in their monitoring and evaluation processes.

LONG-TERM POTENTIAL IMPACT

In the long-run, the city can experience a reduction of traffic congestion due to a broad use of efficient public transport and a decrease in the use of private cars. This can lead to a reduction of Greenhouse Gas emissions and increased air quality, enhancing citizens health prevention and the city liveability.

Increased number of riders will increase public revenue generation due to higher payments from user fees. At the same time, transport-oriented-development approaches around the Expresso Amazonas corridor could increase land values and open the possibility for land value capture and an increase in public revenue generation.

Expanding intelligent mobility systems to the whole municipal and metropolitan area, Belo Horizonte could also experience a better-integrated transport planning not only using technology for increasing the service efficiency but extracting data for better governance and integrated management. This could result in plans, frameworks and approaches to promote a more sustainable, resilient and socially-inclusive Belo Horizonte.

Contribution to Sustainable Urban Development

2030 SUSTAINABLE DEVELOPMENT GOALS

The Global Future Cities Programme aims to contribute the implementation of the 2030 Agenda for Sustainable Development, whilst mobilising efforts to end all forms of poverty, fight inequalities and tackle climate change and ensuring that no one is left behind.

INCREASED LOCAL CAPACITY

Intelligent mobility systems will increase the capacity of the local government in data management and analysis (SDG 17.18), with improved knowledge sharing, expertise and technology (SDG 17.16) enhancing revenue generation as well as promoting the participation of the private sector (SDG 17.1).

SUSTAINABLE CITIES AND COMMUNITIES

By enhancing the use of public transport and integrated transport planning (SDG 11.2), as well as helping inclusive urbanization improving connectivity and accessibility of informal and low-income neighbourhoods (SDG 11.3), intelligent mobility could actively contribute to the creation of a sustainable social environment.

ENHANCED ECONOMY AND INFRASTRUCTURE

Affordable and accessible mobility will help to optimise infrastructure, increasing reliability, sustainability and resilience (SDG 9.1). By making Belo Horizonte a more accessible and vibrant city, the intervention would enhance access to job opportunities (SDG 8.5) and support productive activities, decent job creation, and entrepreneurship (SDG 8.3).

INCREASED RESILIENCE AND WELL-BEING

Integrated planning will also support Belo Horizonte's efforts in addressing climate change, promoting mechanisms for effectively lowering greenhouse gas emissions (SDG 13.2). Safer, greener and more accessible public transport will ensure healthy lives and promote well-being, improving air quality (SDG 3.9) and reducing road traffic accidents (SDG 3.6).

NEW URBAN AGENDA ALIGNMENT

New Urban Agenda is an action-oriented document that sets the global standards of achievement in sustainable urban development, adopted by Member States during the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) held in Quito, Ecuador, in 2016. It sets the framework for sustainable urban development globally for the coming 20 years, laying out how cities should be planned and managed to best promote sustainable urbanisation.

The New Urban Agenda encourages UN-Habitat and others 'to generate evidence-based and practical guidance for the implementation and the urban dimension of the SDGs in close collaboration with Member States, local authorities, major groups and other relevant stakeholders, as well as through the mobilization of experts'.

The Global Future Cities Programme is directly related with the UN-Habitat's draft Action Framework for the implementation of the New Urban Agenda (AFINUA). This framework is organized under five categories: (1) national urban policies; (2) urban legislation, rules and regulations; (3) urban planning and design; (4) urban economy and municipal finance and (5) local implementation.

The intelligent mobility in the Expresso Amazonas will support the development of planning and design processes that are evidence based, integrated and participatory (AFINUA key item 3.1). This will define connectivity structuring the layout of the transport corridor and the neighbourhoods around it (AFINUA key item 3.3).

The intervention will help to the design and the implement systems that ensure social, economic and safe physical access to quality basic services by all (AFINUA key item 4.5). This should go along with the provision of integrated, efficient and equitable urban service frameworks, particularly in unplanned, built urban areas (AFINUA key item 5.4).

Transport-oriented approaches along the Amazonas Corridor will also promote sustainable density and mixed use (AFINUA key item 3.4), offering the chance to employ land value capture and sharing mechanism (AFINUA key item 5.5). The implementation of a better mobility system and its integration with the planning instrument will also include tools for fostering inclusive local economic development (AFINUA key item 4.4).

ALIGNMENT WITH CROSS-CUTTING ISSUES AND THE PROSPERITY FUND

The Global Future Cities Programme seeks to achieve higher rates of sustainable and inclusive growth while increasing long-term investments in sustainable urban projects. Moreover, it will provide greater awareness, capability and confidence while establishing regulatory frameworks resulting in higher incentives for partnerships and financial mechanisms.

The four Cross-Cutting Issues of UN-Habitat, as identified in the Strategic Plan 2014-2019, are mainstreamed to ensure that all UN-Habitat work targets those with the most need and promotes socially and environmentally sustainable cities.[26] In this regard, the interventions detailed for Yangon are shaped under the mainstreaming of environmental safeguards, youth, gender equality, and Human Rights.

The generation and publication of disaggregated data by the Intelligent Mobility System (IMS) in Belo Horizonte will be emphasised to support public policies that meet the practical and strategic interests of vulnerable groups. This will lead to an improved accessibility to public transport for low-income communities as well as woman, the elderly, youth and people with disabilities.

This will contribute to gender equality increasing knowledge of gender issues and addressing the scarcity of gender mobility data and statistics, planning gender-tailored mobility services and better exploiting the synergies between urban and mobility planning.

Furthermore, embedding the IMS in the *Mobility and Urban Inclusion Programme* of the municipality will offer the possibility of integrating urban mobility and transport planning with the upgrade of formal and informal low-income settlements, actively tackling issues of social inclusion as well as economic empowerment.

Potential Benefit	Short term	Medium Term	Long term	SDG Alignment		New Urban Agenda	Programme Objectives and Cross-cutting issues
				GOALS	TARGETS	AFINUA KEY ITEM	1. Climate change; 2. Gender equality; 3. Human Rights; 4. Youth; 5. Sustainable and inclusive economic growth
Increased local capacity for evaluating and monitoring the impact of urban plans, policies, and strategies.	■	■	■	11, 17	11.3, 17.16, 17.18	3.1, 5.1	Climate change; Gender equality; Human Rights; Youth
Increased capacity to prioritize strategies and improved tools for decision making based on informed demographic, economic, cultural, environmental and other holistic projections.	■	■	■	11, 17	11.a, 17.18	1.1, 3.1	Climate change; Gender equality; Human Rights; Youth; Sustainable and inclusive economic growth
Increased ability to better plan inclusive economic growth in a sustainable, climate smart manner.	■	■	■	13, 17	13.2, 17,1	4.1, 4.3, 4.5, 5.5	Climate change; Human Rights; Youth; Sustainable and inclusive economic growth
Increased efficiency of public transport		■	■	9, 11	9.1, 11.2	3.3, 4.5	Climate change; Sustainable and inclusive economic growth
Increased efficiency, quality, and reliability of public infrastructure		■	■	9, 12	9.1, 11.3	4.2, 5.3, 5.4	Climate change; Human Rights; Sustainable and inclusive economic growth
More secure, safe, and accessible public transport, particularly for women and elder.		■	■	3, 11	3.6, 11.7	3.3, 5.4	Gender equality; Human Rights; Youth
Increased mobility and accessibility for poor women and men and other vulnerable groups (elderly, youth, disabled)		■	■	9, 11	9.1, 11.2	3.3, 5.4	Gender equality; Human Rights; Youth
Increased ability to access employment and services, particularly for women and lower income groups		■	■	8	8.3, 8.5	4.4, 4.5	Gender equality; Human Rights; Youth; Sustainable and inclusive economic growth
Increased citizen participation in developing municipal plans and decision making processes.		■	■	11, 16	11.3, 16.7	3.1, 4.5, 5.6	Gender equality; Human Rights; Youth
Integrated plans, frameworks and approaches to promote a more sustainable, resilient, and socially inclusive BH		■	■	11, 13, 16	11.3, 11.b, 13.2, 16.7	3.4, 4.5, 5.4	Climate change; Gender equality; Human Rights; Youth
Reduction in traffic congestion and in air pollutant emissions			■	3, 11, 13	3.9, 11.6, 13.2	3.5, 5.3	Climate change
Better Governance & Integrated Management of BH including better coordination and cooperation between different municipal departments, different levels of government (metropolitan region / city), different stakeholder			■	17	17.14, 17.16	1.4, 2.5, 5.5	Climate change; Human Rights; Sustainable and inclusive economic growth
Improved servicing of informal settlementss & peri-urban areas			■	1, 6, 7, 9, 11, 16	1.4, 6.2, 6.3, 7.1, 11,6, 16.6, 9.c	4.5, 5.3, 5.4	Climate change; Gender equality; Human Rights
Increased quality of life, including the promotion of economic equality and poverty reduction.			■	8	8.1, 8.5	3.5, 4.4, 4.5	Gender equality; Human Rights; Youth; Sustainable and inclusive economic growth
Strengthened municipal finances and increased municipal capacity for renevenue generation			■	17	17.1	3.4, 4.3	Sustainable and inclusive economic growth

Fig. 18. Potential Impact and Programme Objectives Alignment

developed ICT culture in allowing data owners and users make the most of new data sources with creative and inventive utilizations.

COP-BH already constitute a facility which could facilitate integrated data sharing and use for better actions planning and decisions making. The challenge is to expand and enhance human resources and technology to enable COP-BH to actively support and link together municipal departments to define policies, decisions and interventions based on evidence.

Open data policies can also make information interoperable, but this requires specific legal frameworks, the development of an open data governance and the growth of an open data culture.

Balance Demand And Supply-Side Interventions

As it is formulated, the IMS in Belo Horizonte does not prescribe that a unique technology be adopted but rather looks at assessing the capacity and needs within the city to better tailor the technical proposal.

State-of-the-art data applications can be grouped into two main categories, depending on the end user:

- Demand-side looks at customer experience in the form of advanced data provision, new sales channels, trip planning and service rating
- Supply-side transport data includes metrics related to vehicle movements, technological performance, service availability, timetable reliability and pricing when relevant

From a technological point of view, most of these applications can be fed by the same data sources, such as sensors in vehicles (cameras, boarding and alighting or weighting devices and so on), public transport fare payment records when digital technologies are involved in payments or ticket validation and digital signs of personal electronic devices, which includes mobile phones, smart phones, other consumer electronics devices with online communication and personal vehicles equipped with GPS tracking.

It is a crucial precondition of the efficiency of the intervention in Belo Horizonte that the demand and supply sides of the mobility sphere should have a balanced access to new data sources. In practice, this often implies that data should be made available for various departments of the same transport organisation or even be shared between multiple agencies within a city.

Without these channels for shared information, it may often be the case that the impact of improved

Success Factors

The following statements are considered as evidenced success factors, based on international best practices, for the interventions in Belo Horizonte in order to achieve maximum impact in line with the Goals, the prosperity fund, and the cross-cutting issues. Success factors are divided into spatial, financial and legal and aim to address potential barriers for the long-term sustainability of the interventions.

SPATIAL CONSIDERATIONS

Capacity Development

Knowledge and human capacities must be developed alongside new data improvements. In parallel with the investments in technology, the capacities of data management and analysis should be strengthened within the transport and city planning department. This is the only way in which the new information can be turned into actual change in city and transport planning.

Use Of Data In Different Transport Modes

Making transport data interoperable through modes is one of the key success factors of impactful interventions. The majority of the information content of transport data has no special features that prevent its application in several transport modes. Institutional barriers and legal requirements should be addressed so that travel data is not restricted to only one mode of transport or even one operator within that mode.

Use Of Data For Multiple Planning And Operational Purposes

Using transport data efficiently means also successfully allowing their re-use in areas beyond the original purpose of collection, within transport planning and operational processes as well as others. Open data policies proved to be successful in many cities with a

service provision (supply-side) on customer experience (demand-side) remains hidden and, therefore, the operator will not be able to monitor the effectiveness of interventions.

At the same time, matching multiple sources of data (data fusion) can exponentially increase the usefulness of demand data as a comprehensive picture of ridership patterns renders causal inference, forecasting and other statistical analyses significantly more robust.

Targeted Data Collection And Programming

The IMS will explore different possibilities for data gathering, from making use cameras and sensors that SitBus already offers to the integration of data capture devises within wifi access points that the municipality is considering to install throughout the city.

To ensure that the new data investment serves to enhance inclusiveness in Belo Horizonte, it will be necessary to create a technology app to disaggregate data by sex, age, income level and disability.

Spatially locating this information with travel patterns and characteristics households and individuals can allow the understanding of gaps in service provision and better targeting of low-income communities and vulnerable groups for an increased connectivity and improved area-wide transportation needs and services.

Awareness

Trust in data-based applications must be achieved. Lack of trust on the users' side can be a barrier to the leverage effect of data interventions.

In this regard, awareness campaigns on the collection of data and its purpose can be of value.

Integrated Transport Planning

To achieve the full potential of the intervention, some enabling conditions need to be in place to promote integrated transport planning. It is essential to design transport systems that follow the demand and manage to have the adequate number of passengers.

- Transport planning should be coordinated with land-use policy and density
- There should be a clear governance structure
- Non-motorised or active mobility systems should be an integral part of transport plans
- Transport plans should be linked to the city's development prospects in order to manage future demand

BH Trans already cooperates with the urban planning departments of the city and is aligning its plans to state and metropolitan level strategies. However, this collaboration should be enhanced. Especially in the development of the Amazonas Corridor, close collaboration with CBTU, which is currently not realised, would help to expand inter-modality between bus, BRT and metro, building the base for a true metropolitan transport system.

Monitoring And Benchmarking

The benchmarking of the efficient service provision is essential. In this regard it is important to have customer-focused performance metrics that consider the actual experience of transport users.

FINANCIAL CONSIDERATIONS

Private Sector Engagement

Besides the capital investment dedicated for the intervention, the new data system needs to be maintained and operated in the long-run. In this regard, the involvement of the private sector through a public-private partnership can be a sustainable way for building, implementing, operating and maintaining the system. As previously mentioned, Belo Horizonte has a lively ICT environment which could profit from the IMS and, in turn, providing gains that can summarised as:

- Efficiency gains in line with the overall aims of a traffic management system
- Private companies may have systems and technological solutions to help to set up the system
- These companies could bring in experience that can be transferred to other companies and the city government
- They could have greater capacity to manage and analyse data – especially big data

However, private engagement could imply some risk that should be mitigated with specific measures to ensure that the interventions serve the advantage of the city and not of the interests of the private sector:

- Open source information that ensures that prevents monopolies
- Open data policy that ensures that investments in data can be used for other transport projects, transport modes or other projects of the city
- Privacy laws that ensure that the private sector does not monetize the data without the consent of the citizens
- Life cycle perspective in the costing of the services

Land Value Capture To Capitalize On Increased Land Values

Integrated transport plans and a more efficient transport system can lead to increase revenue generation through mechanisms such as land value capture, extraction and impact fees. In order to optimise the full potential for revenue generation within the intervention, the Expresso Amazonas Corridor should consider these mechanisms as a way to capture increased land values.

LEGAL CONSIDERATIONS

Open Data Policies

Open data policies and regulations are essential to ensure that the data is shared and interoperable by different operators and agencies. This is a necessary condition to maximise all the potential gains of the intervention in promoting integrated transport planning.

Additionally, open data policies could allow the use of data by entrepreneurs that could use it for new innovative projects, which could enhance small and medium sized enterprises.

Moreover, open data policies are essential to ensure transparency and allow citizens to monitor the performance of the transport system and held the city government accountable.

If the public sector is involved, open data policies can avoid the creation of monopolies through which the public sector can only contract the service provider that has access to the information

Privacy Law

Brazil recently approved a comprehensive data privacy regulation. This is an essential step for the use of any data-related project as it ensures that the collection of data from travellers and other users is not used for purposes of which citizens are unaware. Moreover, the law regulates the balance between opportunity for private companies to profit while maintaining citizens' rights.

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