

**Asia-Pacific Environmental Innovation Strategies (APEIS)
Research on Innovative and Strategic Policy Options (RISPO)
Good Practices Inventory**

Integration of Land Use and Bus System in Curitiba, Brazil

Summary of the Practice

Keywords: land use, bus network transit

Strategy: Development of environmentally sustainable transport systems in urban areas

Environmental areas: Climate change, Air pollution, Urban environment

Critical instruments: Design, planning and management, Economic instruments, Organisational arrangements, Technologies

Country: Brazil

Location: Curitiba

Participants: city government; research and urban planning institute (IPPUC); public transportation corporation (URBS), private bus operation firms⁵

Duration: 1974 - ongoing

Funding:

- Work based on the Master Plan in 1965 was financed by the Development Company of Paraná and by the Curitiba municipal government's Department of Urban Development.
- Operation of the bus system is financed completely by bus fares, without any public subsidies.
- The north-south Bi-articulated Bus Line project (approved in 1995) was financed by the Inter American Development Bank, the private sector, and the Municipality of Curitiba.

Background:

Curitiba is the capital of the state of Paraná. It is located in southern Brazil and has an area of 432 square kilometres (279 sq. mi.). The city's population in 2000 was 1,586,848, with a metropolitan region population of 2,725,629. The Gross Domestic Product in 1996 was U.S.\$15,393 million for Curitiba and U.S.\$17,910 million for the metropolitan area of Curitiba. Curitiba's GDP per capita in 1996 was U.S.\$9,750, about twice the national level (U.S.\$4,889).

The first urban plan for the city was developed in 1943 by Alfred Agache, a French urban planner. The plan assumed the dominance of the automobile and the principle approach was massive infrastructure investments, including construction of circular boulevards and major radial arteries.

Due to financial difficulty in carrying out Agache's plan and the pressure of rapid population growth, the plan for the city's urban development was reconsidered and the principal directive of the Preliminary Plan of 1965 (subsequently known as the Master Plan) was developed. The idea was to develop the city along linear roads in order to increase the efficiency of circulation and the distribution of services. It proposed infrastructure investment in an organised fashion, and planners hoped to facilitate the city's lagging urban development. The transit system began to operate in 1974, when architect Jaime Lerner was the Mayor of Curitiba, and has evolved since then.

Objectives:

The Master Plan for Curitiba has the objective of adapting the zoning and land-use requirements to the socio-economic and territorial development of the city.

Description of the activity:

The transportation system in Curitiba is highly integrated with Land Use and the Road System.

The key concept is the structural axis, the physical form around which the development of the city and its transportation network is organised.

- **Land Use:** The highest levels of residential and commercial development are concentrated in the two blocks at the centre of the spine, with diminishing densities in the blocks to either side, thus preserving large areas for low-rise residential development in the sectors between axes.



(Source: IPPUC homepage)

- Road System:** The three-part road system of each axis is made up of one central street with exclusive lanes for efficient public transportation and slow local access traffic lanes with parking. To either side of the central street are one-way arterial streets of traffic (express lanes) headed into or away from the downtown area. This road system was created through a re-definition of the existing streets, not by resizing the streets or constructing overpasses.



(Source: IPPUC homepage)

- Mass Transit:** Since 1974, an express bus system, called the Integrated Transportation Network, has been operational in Curitiba. It links downtown to the neighbourhoods through exclusive traffic lanes. The lanes enable a considerably higher average bus speed, without jeopardizing passenger safety. There are now 58 km of exclusive bus lanes which crisscross the city along its north, south, east, west and southwest axes. The great axes are complemented by 270 km of feeder routes and 185 km of inter-district routes, servicing about 65% of the urban area. If added to the conventional routes, Curitiba's urban transportation system covers the entire municipal area, integrating its network with 10 cities of the Metropolitan Region.



(Source: IPPUC homepage)

Critical Instruments

Overview

Curitiba's transport system is innovative in design/planning in that it introduced an all-bus network transit system. Its success was also determined by innovative instruments in its operation; economic

instruments such as single-fare public transport and payment per kilometre; institutional arrangements; and technology components, including tube stations and bi-articulated bus.

Design, planning and management

All-Bus Network Transit System

Curitiba's transportation network is made up exclusively of buses and succeeded in providing excellent access and mobility. The two features essential for the success of this all-bus network transit system are (1) reliable high-capacity buses running along trunk lines on the structural axes where the greatest population lives and works, featuring exclusive lanes with a limited number of cross streets, signal pre-emption, high platforms for entry and exit, and pre-paid boarding; and (2) a complementary network of colour-coded feeder and express buses, all with free transfer, providing dense coverage of the entire city .

Economic instruments

Single fare of public transit

Until 1979, the fares of the bus transit system reflected the operational cost of each line separately. Because they were less lucrative, the longer lines had higher fares, posing high costs for the low-income population located at the periphery of the city. Since 1979, with one single fare reflecting the cost of the entire system, persons commuting long distances (often the low-income population) are subsidized by those making shorter trips. Besides being socially just, the single fare facilitated the implementation of fare integration between different companies. It is estimated that around 80% of users benefited by the integration.

Payment per kilometre

The bus system is organised by URBS (Urbanization of Curitiba S/A), the public transportation corporation, and 16 private companies are sub-contracted to operate and maintain the buses. In 1986 the operating companies, which until then had received income directly from the ir passengers, changed to a system whereby they were paid per kilometre. The municipal government collects detailed operational information (fleet, timetable, kilometres run, etc.), audits the implementation, collects income received daily from the whole system, and pays the operators for services rendered in real costs. Detailed regulations establish the rights and obligations of the operating companies, define the faults and penalties, and seek to eliminate waste while constantly improving the quality of service. This arrangement ensures the fair distribution of income among operators and prevents unhealthy competition among drivers over specific routes.

Organisational arrangements

Function of auxiliary branch

An auxiliary to the city's executive branch of government, the Curitiba Institute of Urban Planning and Research – IPPUC (Instituto de Pesquisa e Planejamento Urbano de Curitiba) was responsible not only to plan, but also to test solutions. This dual responsibility has been central to its success. Due to the dual responsibility, new plans are generated, accepted by the community, and put into practice quickly. The population began to trust the ideas of the Institute, and this trust has largely been responsible for changes in the mentality of the city's inhabitants. The community began to believe in the IPPUC and to support its ideas of urban transformation, to suggest improvements and to demand modifications.

Technologies

Tube Stations

The Tube Station, started in 1984, is a bus platform elevated to the level of the entrances/exits of the bus, where automatic doors operated by the tube conductor open parallel to the bus doors. Passengers pay an entrance fare at the turnstile and wait for their respective direct or express bus to pass. Disembarking passengers leave the stations through a direct exit. The Tube can allow controlled access and safe and secure embarkation. The establishment of the Tube Stations guarantees that the bi-articulated buses (see below) have the necessary operational conditions to

support (with more vehicles) the growth in demand predicted for the next 12 years. The embarkation time fell to one-eighth of what it was before these facilities were introduced.



(Photo by Mr. Masato Koto, Mets Research & Planning, Inc)

Bi-articulated Bus (Surface Metro)

The bi-articulated bus has a large capacity (270 passengers) and travels in an exclusive lane. It has no steps or fare collection and use the Tube Station for passenger embarking and disembarking. The first line was implemented in December 1992, with 33 vehicles carrying 100,000 passengers per day on the south-west axis. Due to the system design with special lanes, pre-paid passenger boarding and the priority the buses receive in road hierarchy, the bus system can operate with a much higher capacity than traditional city bus systems. In terms of cost-effectiveness, the bi-articulated bus system in Curitiba is very effective with the cost of U.S.\$3 million per kilometre to construct compared with U.S.\$8-12 million per kilometre for a tram system and around U.S.\$50-100 million per kilometre for a subway. The new system offered riders greater comfort, and operating costs fell 6% lower than the previous fleet.



(Photo by Mr. Masato Koto, Mets Research & Planning, Inc)

Impacts

The Integrated Transportation Network promoted the use of public transport and reduced the use of private cars. Around 1.9 million passengers use the bus transit system daily with an 89% user satisfaction rate. By 1999, 31,000 new users have been attracted to the Direct lines since 1991 and 10,000 attracted to the Bi-articulated Express lines since 1992. This amounts to a diversion of 41,000 auto trips to transit, indicating that almost 9% of the automobiles in the city are now staying in their garages. This change will reduce congestion, fuel consumption, and air pollution, and result in a better environment for the entire population. Actually, Curitiba has shown one of the lowest levels of ambient air pollution in Brazil.

This reduction in automobile use is seen regardless of the fact that Curitiba has among the highest household incomes and the second-highest automobile ownership rate in Brazil.

Lessons Learned

- *A low cost metropolitan transport system is achievable.* By utilizing the existing corridors and adopting measures to intensify development along these corridor roads, public transport systems can be established at relatively low cost. This low-cost public transportation system showed the ability to more quickly and more effectively serve an entire metropolitan population.

- *The integration of land use, road systems and mass transit is a powerful tool.* Through the use of land-use instruments, local governments can direct population growth and thereby establish effective systems of transportation.
- *Vision, leadership, and flexibility lead to success of urban planning.* Curitiba is one of the few cities that realized its urban plan. The factors of Curitiba's success are these: a clear long-term vision, strong leadership to implement the plan, and flexibility in adjustments by utilizing a step-by-step approach.

Potential for Application

The all-bus transit strategy in Curitiba has been applied in other Latin American cities such as Bogota (Columbia)¹ and Quito (Equador)². This strategy might be applicable in moderately sized but highly congested cities around the world. It might also be an integral part of a much more complex metropolitan network, providing efficient feeder service to, and extensions of, a rail transit system.

In application, we need to note that (1) the strategy was initiated when auto ownership was low, public transportation needs great, and prior to the traffic congestion that was anticipated with an exponential growth in population; and (2) it is important to balance the overall project and it will not work unless individual sectors are fully inter-linked.

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¹ Refer to the practice, "TransMilenio Bus Rapid Transit System of Bogota, Colombia"

² Refer to the practice, "The Electric Trolleybus System of Quito, Ecuador"

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Information date: 4 December 2002