Curitiba, Brazil

Transportation Case Study

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History of Curitiba (By Brian Karis)

The city of Curitiba is world renowned for the transportation network and urban planning throughout the city. For instance, the chairman of urban planners in Istanbul praised Curitiba as “the most innovative city in the World”. Great leadership and adherence to smart transportation planning tenants has helped Curitiba, Brazil strive towards becoming a sustainable city while gaining its strong reputation as a great example of successful urban planning.

The city of Curitiba, Brazil is located in southern Brazil just south of São Paulo. The city was first founded by the Portuguese in 1693 and named “Vila da Nossa Senhora da Luz dos Pinhais” (Our Lady of the Light in the Pine Forest established). The name was later changed to “Curitiba” in 1721. In 1842, Curitiba officially became a town and was named the capital of the state of Paranà in 1954. The population has grown exponentially over the past half a decade, mostly due to the rapid immigration after World War II. The increase caused great concern for the people of Curitiba. The population of the metro area has grown from 130,000 in 1950 to 2.8 million in 2005, while covering an area of 166.4 square miles. Furthermore, the population in Curitiba is expected to reach 3.1 million in 2015. The people of Curitiba had already seen the negative effects of sprawl in São Paulo to the north and they did not want this to happen in Curitiba. City planners needed to find an effective and cheap transportation plan in Curitiba in order to prevent urban sprawl.

The first plan developed for Curitiba was called the Agache Plan. In 1943 this plan was conceived by the French urban planner and architect named Alfred Agache. The plan had many strong ties with present day Paris, France in that it called for the
creation of many wide avenues for vehicular transportation. These arterials consisted of five lanes of traffic moving in each direction radiating and connecting important intersection points. In addition to expanding the roads, this plan also included the building of a large overpass that would span two squares in the downtown area. The plan also planned to create new sanitation measures, additional housing and industrial zoning. The goal of this plan was to strengthen the city core by providing increased vehicular movement in and out of the city.

There were two main reasons for why the Agache plan failed in Curitiba. The first reason is the fact that the city could not provide the funding needed for the large infrastructure changes called for by the Agache Plan. At the time, Curitiba was a poverty stricken city which made it impossible to fund such a large project. Secondly, the plan called for the destruction of many historically significant buildings in order to lay down the large arterials. Many local residents opposed the destruction of these buildings that meant so much to the city’s history. Though this plan was unsuccessful in its implementation, it did raise local public awareness about the importance of city planning in the future.

The failure of the Agache Plan led the mayor Ivo Arzula to call for new proposals for a new urban design for the city in 1964. This led to the creation and implementation of the Master plan. Created in 1965 and implemented in 1971, the Master Plan addressed urban planning issues with efficient public transit and many environmental and social programs. The plan was developed by the Curitiba Research and Urban Planning Institute (IPPUC) which consisted of a team from the Universidade Federal do Parana. It was led by the architect and planner Jaime Lerner. Jaime Lerner was a huge force for the
successful implementation of the Master Plan. In fact, Lerner’s involvement with the development and implementation of the Master Plan led him to becoming mayor of Curitiba for three separate terms between 1971 and 1992. His involvement in the local government solidified the successful implementation of the Master Plan. The IPPUC not only monitors and runs the system, but also operates a website where the public can obtain bus routes, schedules, bike routes and other pertinent information to the system.

The Master Plan was a large improvement on the Agache plan. Instead of giving priority to vehicles, it gave public transit the right of way. It achieved this through the implementation of an efficient and sustainable transit network along with the use of the Trinary Road system. This road network gives priority to cheaper and cleaner modes of transportation as well directing the growth of the city along five linear corridors. The proposed transit network consists of a complex system of buses called the Integrated Transport Net (RIT). The plan also makes it easier for pedestrians and cyclists to move about the city easily and efficiently. Lastly, this plan includes many programs to improve the environmental and social sustainability of the city.

The rest of this report consists of a detailed description of the transportation network and planning in Curitiba, Brazil. First, the transportation network will be explained along with the Trinary Road System concept. Next, the IPPUC application of the five tenants of smart transportation planning for Curitiba’s Master Plan will be evaluated. Lastly, this report will look at the different environmental and social programs put into place that help to achieve different levels of sustainability in Curitiba.
The transportation network in Curitiba is a well planned and practical network which has been mimicked throughout the world. It is a system that limits the amount of car use and promotes other modes of travel. The system integrates public transit with biking and walking, moving people efficiently and quickly while creating a pleasant atmosphere for travel. The transportation network effectively serves the rapidly growing population while limiting the amount of sprawl, which is a key concern for many Curitibans.

The main element of the transportation network is the Rede Integrada de Transporte, or Integrated Transport net. The Integrated Transport Net, abbreviated as RIT, is a complex, but simple to use public transportation system. It hinges on five major types of buses; the express, inter-district, direct, feeding and conventional buses, each of which serves a particular purposes. The express buses travel radially out from the city center along five major corridors and act much like an above ground subway. They are usually bi-articulated and carry up to 270 passengers in a single trip. The inter-district buses travel in two circles around the city center allowing quick access from one sector to the next. The direct buses are used as the quickest way of travel between two points, as they cover large distances with few stops. The feeding buses link a particular neighborhood to the express bus via a bus terminal. Finally, the conventional buses are much like what people in the United States are used to. They run in loops, connecting areas of interest within particular portions of the city. The RIT also has two other specialized buses. One is specifically for tourists that in the area, offering tours in many
languages. The other bus is used to connect all the hospitals to one another allowing the public access to all local hospitals.

Integrating the five major types of buses within the RIT seems like a very difficult task. However, by using the trinary road system, Curitiba is able to make the system extremely efficient and easy to use. The trinary road system integrates all the parts of the transportation system as well as channeling city growth along the five major corridors of the RIT system. The trinary road system is comprised of three main routes shown in figure 1. The route in the center (shown in red) is made up of two components. It has dedicated lanes in the center used exclusively by the express buses bringing people to and from downtown. This dedicated area is then surrounded by lanes for local traffic as to allow access to the local area by car. Running parallel to this center route are two, one-way direct line routes (shown in green and blue). These routes have dedicated lanes for direct line buses and also lanes for local traffic allowing access to downtown.

Figure 1. The Trinary Road System
The most important part of the trinary road system is the bus terminal (See figure 1) which integrates the three main routes together. The bus terminal works much like a subway station. The dedicated express lanes of the trinary road system intersect the center of the terminal and passengers from inter-district, feeder and express buses are loaded and unloaded using platforms (See figure 2). The bus terminals also acts as a mini-market area complete with small newsstands, cafes, and seating areas creating a pleasant atmosphere for the passengers.

![Figure 2. The Bus Terminal](image)

On the opposing side of the platform there are bus tubes (see figure 3) which act like a local bus stop for direct line and conventional buses. These tubes are used throughout the city as the local bus stops. They allow protection from the weather as
well as oncoming traffic making it an ideal experience for the passengers. Bus tubes are also extremely efficient. They allow eight passengers to enter and exit the bus per second limiting delay time between stops. Another important aspect of the trinary road system is that a person only needs to pay once when entering the bus tubes or terminals. This single fare allows you to exchange buses and move throughout the city. This greatly reduces the travel time and delay between stops.

Figure 3. Bus Tubes

Although the RIT is the major part of the transportation system the pedestrian walkways and areas are very important to the vibrance of Curitiba as well. As mentioned earlier the transportation system focuses around five linear corridors which radiate from the center of the city as shown in figure 4 on the following page. Unlike other cities, particularly in the United States, the city center acts as a giant terminal or hub of the city as opposed to merely an intersection point. Starting in 1971, this city center has been blocked off to all motorized traffic and was reserved for pedestrians only. Primarily comprised of retail stores and businesses, the center faced heavy opposition by the public initially, but after a sharp increase in sales almost all of the opposition turned
into praise. Now this area covering 50 blocks is the heart of a wealthy vibrant city. However, it is not only in the city center where walking is encouraged. Many of the major roads have large walkways providing a safe and pleasant atmosphere for pedestrians.

![Figure 4. The linear corridors and city center](image)

Aside from public transportation and walking, bicycles have also become a major part of the transportation network in Curitiba. Currently there are 150 kilometers of bike paths, both along roadways and exclusive paths. The RIT also features the capacity for bikers to transport their bikes with them when traveling by bus. This is greatly increasing the appeal of biking and ridership has steadily increased.
In conclusion, the extensive transportation system of Curitiba has allowed it to become a prosperous and growing city. Through careful planning and integrating various modes of travel, the system has become a worldwide example of efficient transportation. This could not have been accomplished unless the IPPUC followed the five tenants of smart transportation.
Smart Transportation Planning (By Jeff Veilleux)

Due to Curitiba having such a large population of 2.8 million people in the metropolitan area, outsiders may jump to conclusions, believing that it would be a typical metropolis of congested roadways and chaotic land development. Curitiba, however, is the exact opposite. Curitiba creates a sense of place through its great transportation and urban planning. Curitiba’s city planning has been so effective because the IPPUC follows the five tenants of smart transportation very closely. These tenants include:

- Using broadly defined goals
- Planning for desired outcomes
- Developing solutions for maximum accessibility
- Giving priority to cleaner, cheaper, and more efficient modes of travel
- Diversity of modes for different needs

In order to see the extent to which the IPPUC has followed the tenants of smart transportation, we will explore each tenant with respect to Curitiba’s transportation and urban planning.

As for the first tenant of smart transportation, which is using broadly defined goals, the IPPUC has been able to achieve this quite successively. The broad main goal that the IPPUC has set forth in its “Master Plan” is “to coordinate the city's urban planning and monitoring process, conducting sustainable development through compatible actions between the city and its metropolitan area” (IPPUC website). Overall, the organization wants to make sure that all of the planning decisions only have the most positive impact on the region as a whole. In order to accomplish this goal Curitiba has closely followed the second tenant of smart transportation, which is planning for desired outcomes.
The IPPUC effectively outlines and follows their plan for desired outcomes. The “Master Plan” focused on achieving a few objectives, which include minimizing urban sprawl, reducing vehicular traffic, preserving historical sites, and providing accessible transit. All of these objectives that the IPPUC wanted to achieve were accomplished through the “Master Plan” that was implemented in 1965, which involved transportation and zoning aspects. The “Master Plan” focused on having a transit oriented city. They implemented the Integrated Transit Net (RIT) an extensive bus rapid transit system. In this network there are five main types of buses, 21 main terminals, and many small bus tubes (stops). Having such a transit system allows citizens to have other options than just a car. With having this system in place, vehicular traffic was reduced and it also allowed for accessible transit. The zoning plans is what helped reduce urban sprawl and what saved historical sites. In Curitiba there is a very distinct zoning pattern. High density, large, multi-use buildings are located along the main corridors. As you move farther from the main corridors the buildings become smaller, less dense and become strictly residential areas. Within the different zones the historical buildings were able to be converted into useful buildings while maintaining there historical integrity.

Once again the “Master Plan” plays a huge role in the extent to which the concept of smart transportation is followed in Curitiba. The implementation of the “Master Plan” allowed accessibility to be maximized instead of maximizing mobility, which was the focus of the earlier “Agache Plan.” Both transportation and urban planning play a huge role in achieving maximum accessibility. With having the very distinct zoning patterns and multi-use buildings, communities were able to be more centralized and less dependant on having to travel to meet there needs. If any sort of traveling was needed,
the bus system allows for easy accessibility to places. Accessibility is so easily achieved from the bus system because of the five types of buses that are incorporated within the system. Each type of bus allows access to different areas of the city. In achieving maximum accessibility the IPPUC has followed the forth tenant of smart transportation, which is giving priority to cheaper, cleaner more efficient modes of travel.

In the transportation network, buses are given priority of travel. Using the trinary road system with exclusive lanes for buses, the network separates automobile traffic from transit. Having this separation of traffic is imperative to make the bus system run efficiently. Another aspect that allows the buses to run efficiently is the sensors that are found on the buses and on the traffic lights. These sensors allow for the signal at a stop light to be changed so that the time standing at a traffic light is minimal. Another aspect that gives motivation for the citizens to use transit is the cheap fare of 30 to 40 cents per trip.

Although transit is Curitiba’s main focus for traveling, which is not necessarily cleaner, it takes away the demand for the need to travel by automobile. This reduces the amount of emissions that are being released into the atmosphere, so as a system as a whole the transit system is cleaner than an automobile dependant city. Therefore the transit system can still be seen as meeting the tenant of giving priority to cleaner modes of travel.

Curitiba also follows the final tenant of smart transportation, which is to supply a diversity of modes for different needs. The buses, which are the main mode of travel, are diverse within themselves. There are five different types of buses, each serving a different purpose. Each type of bus has a specific route and frequency of stops to bring
people efficiently and quickly to their destination. Some buses are localized buses which stop more often. There are also buses that come from the outskirts of the city to bring people to the city center which do not stop as much.

Although transit is Curitiba’s main way to travel, the citizens also have other options, such as walking. Curitiba is a very pedestrian friendly city. The pedestrian only city center acts as a hub for the city. The five linear corridors of the bus network meet and circle the city square, allowing citizens access to the diverse downtown area. In addition to the pedestrian only city center, the separated walkways along roadways allow Curitibans to walk to their destination, safe from motorized traffic. Also in Curitiba bicycling is starting to be seen as another way to travel. From a plan starting in 1992, Curitiba has begun to add bike paths throughout the city. Bike paths connect most bus stops and buses allow passengers to travel with their bikes. This makes it easier and more convenient for people to travel once they reach their destination.

Curitiba has closely followed all of the criteria of smart transportation. The transportation system supplies many different modes of travel, so travelers have choice. Also, these modes are cheaper and cleaner than the car. Curitiba has achieved the outcomes that the IPPUC original hoped for from the start of the implementation of the “Master Plan.” The “Master Plan” has allowed Curitiba to maximize accessibility throughout the city. It seems that Curitiba’s main goal has been accomplished to this point and many positive outcomes are being seen by the city as a whole. The system is not only running efficiently, but it is also leading to an extremely sustainable city.
Sustainability (By Kelly McCartney)

Sustainability can be defined as, “the stewardship of natural and human-made resources so that the quality of life and the health of our cities, countryside and open spaces do not deteriorate from one generation to the next.” Through the implementation of Curitiba’s Master Plan, the city has reached different levels of sustainability throughout the city. These different levels can be seen in Curitiba’s transit network and its environmental and social programs that have been put into place over the last forty years.

The first level of sustainability in Curitiba can be found in its transit network. In the 1970’s, about 7% of city travel in Curitiba was done by transit. Later, in the 90s, about 25% of city travel was done by transit. Today nearly 75% of city travel is accomplished using the transit system that is in place. This is approximately equal to 23,000 passengers per hour, more than New York the United States’ most transit oriented city. This increase in rider ship is due to the highly efficient bus network that was described earlier. The Master Plan has given priority to the bus network instead of vehicular traffic which makes transit the better option of travel. It has also made the transit option very affordable even for the low income households who usually only spend about 10% of their income on transport. Also, in the downtown area, the Master Plan has given priority to pedestrians making it unnecessary to drive into the city to reach the markets and businesses.

Along with providing the most efficient way to navigate around Curitiba, the transit system actually produces a profit. This is due to the relationship between the public and private ownership of the bus network. Private companies buy the buses for
the network and the assigning of routes and the setting of fares is handled by the city itself. The city pays the contractor by the kilometer traveled by each bus that the company owns. Fares for riding the buses range from thirty to forty US cents with one fare allowing accessibility to the entire city. The fares assigned by the city are enough to pay for the full cost of maintaining the system including the administration required to run such a system. From this, it can be seen that the transit network in Curitiba is self-sustaining and does not require precious tax dollars from the people of Curitiba.

The next level of sustainability can be found in the environmental programs of the city. Curitiba, Brazil is often referred to as the “ecological capital of Brazil” because of its achievements in its environmental policy. The continued success of the transit system has led to 25% less congestion than other Brazilian cities of similar size. This fact combined with the use of green fuel by the transit system has led to a 43% decrease in the particulate emissions resulting in cleaner air.

Next, the amount of parks and open spaced has increased dramatically from 5$\text{ft}^2$ of open space per resident to 559 $\text{ft}^2$ of open space per resident. With this increase in parks and open space has been the planting of 1.3 million trees and the creation of 16 parks and 1000 plazas. In addition to providing aesthetic value to the city, these parks also provide much needed flood control of the Iguazu River tributaries that has caused damage to the city many times in the past due to flooding.

Another factor contributing to Curitiba’s environmental reputation is its three main recycling programs. The first of these three plans, “Garbage that is not Garbage” was created in 1989 and is like that of the system that is in place in the United States whereby households sort their recyclable materials from the trash and leave it by the curb
to be collected by the city. Another program created in 1989 is the “Garbage Purchase” program. This program is designed to encourage recycling in low-income areas. These areas are usually more difficult to reach by the conventional waste management system. Residents in these areas are encouraged to bring their garbage and recycling to local specified centers in exchange for bus tokens, food parcels, and children’s school notebooks. Nearly 31,000 families have benefited from the “Garbage Purchase Program” by receiving nearly a million bus tokens and 1200 tons of surplus food and school notebooks all in exchange for collecting over 11,000 tons of garbage.

The last environmental program is called the “All Clean” program. This program temporarily hires retired and unemployed residents to clean up specific areas of the city where litter has accumulated. Many recovering alcoholics and homeless people are hired through this program in which all proceeds earned from recycling goes back to social services provided by the city for its residents. Here again participants can be awarded for their work with food or transportation tokens. With all three of these programs the policies are keeping the city clean while also helping the less fortunate. These recycling programs help to create a sense of pride for the people of Curitiba. As evidence of the programs successes, 70% of households in Curitiba (about 22,000 families) participate in the recycling programs wherein 2/3 of the city’s daily garbage (about 100 tons) is recycled.

The city officials of Curitiba, Brazil realize that a system such as the one in Curitiba cannot be successful without public support. Therefore, the planning in Curitiba has always included many programs, such as the ones stated above under environmental policy, to improve the quality of life in the city. The retired buses of the transit network
also help to improve the quality of life of many Curitibans. These buses become mobile training centers which provide education for many people for a small cost of one dollar for courses in auto mechanics, electricity, typing, hair dressing, artisan work, etc. At the end of these training sessions, students are placed in jobs throughout the city. In addition to providing a cheap education, the retired buses may also provide free transportation to parks and open spaces.

In addition to the sustainability of the bus network, city officials have also made great strides in sustainability through way of land use in the city. Growth in Curitiba is directed along the five linear corridors, specifying four different areas of development. Closest to the linear corridor, zone four contains eight to twelve story buildings. The following zones extending out from the linear corridor after zone four are zone three, (three to five story buildings), zone two, (two story buildings), and zone 1 consisting of one story buildings. By specifying specific areas of development, the city planners in Curitiba have allowed easy access to transit while also preventing sprawl in the region.

In addition to directing land use, city officials have also made it very easy for citizens to obtain information about the building potential of any plot of land. In order to ensure that each plot is used efficiently, anyone wishing to obtain or renew a business permit must provide city hall with information used to project traffic generation figures, infrastructure needs, and parking requirements. Doing so guarantees that any changes to the existing land use of a particular plot will only support and improve the system already in place around that particular area.

The last way that the planning in Curitiba, Brazil helps to create an improved quality of life for its citizens is through its preservation of historical buildings. The land
that many of these buildings reside on is considered of high value. To compensate for personal loss due to regulations prohibiting the destruction of such buildings, owners within the historic district have the right to transfer the building potential of their plots to another area of the city. In doing so, city officials in Curitiba, Brazil are preserving the historical buildings that mean so much to many of the people in the city but they are also compensating owners who choose to help preserve such sites.

Curitiba, Brazil has reached many of its goals of its urban planning process but there is still much to be done. There are still areas of poverty, or shanty towns located on the periphery of the city. Even though there have been huge advances in the environmental aspects of the city, there are still areas that are not connected to the sewer system and still suffer from extreme environmental damage. Even with these pitfalls, Curitiba is still considered as a model for modern day urban planning. In 1992, the Urban Forum, a collection of municipal leaders and academics from around the world, was held in Curitiba. At this gathering, the “Curitiba Resolution” was passed. This resolution named actions that each Forum participant vowed to work for in their own city. These actions encompassed the idea of working to extend basic services without additional environmental degradation and also to encourage progress in improving energy efficient cities while reducing all forms of pollution. After this Forum was held, the “Curitiba Resolution” was then presented as the benchmark for urban planning at the United Nations Conference on Environment and Development (UNCED) which was held in Rio de Janeiro later that year. With the passing of the “Curitiba Resolution” it can be seen that Curitiba is viewed as a model city for successful urban planning.
Conclusion (By Group)

Overall, Curitiba has created a sustainable and efficient transportation system through following the five tenants of smart transportation. The creation of the IPPUC and the Master Plan combined with strong governmental leaders, such as Jaime Lerner, allowed for a unified force towards the improvement of the city. The extensive transit network along with the strict regulations on land use has created an accessible and organized city. Curitiba has been globally recognized for its innovative advancements in urban and transportation planning. It has become one of the great examples of an efficient and sustainable city.
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