



IMPROVING TRANSIT ACCESS FROM CAGUAS TO SAN JUAN

Pilar Rodríguez

Massachusetts Institute of Technology

Research Advisors: Nigel H. M. Wilson and Ken Kruckemeyer

1 OBJECTIVE

The main purposes of this research are:

- To understand the travel characteristics between Caguas and San Juan.
- To design a public transportation service to improve access from Caguas to San Juan accounting for technical, political, social and economic constraints.
- To design a service that connects Caguas riders to Tren Urbano.

2 MOTIVATION

Commuting between San Juan and Caguas has increased during recent years. It has been estimated that external trips into San Juan Metropolitan Area –SJMA- in 2010 will be at least 20% higher than they were in 1990; highways connecting Caguas and San Juan account for 43% of that growth. This has led to congestion on the two main connecting highways, PR-1 and PR-52 (Figure 3).



Figure 1. Regional Map from Caguas to San Juan

Although there is a public transport service between Caguas and San Juan called *públicos*, most trips are made on private cars. Travel-time during peak hours (1hr 20 min approx.) can be up to 4 times the travel time during off-peak hours (usually 20-25 min). Solutions based on further reliance on the automobile seem to be infeasible due to financial and sustainable development concerns. It requires large investment in highway infrastructure and will cause a negative impact on Puerto Rico's environment deteriorating air quality. Therefore, implementing a new public transit system, with higher quality than the current service, appears to be a more sustainable approach to preventing greater congestion and improving public access between both cities.

To ensure the effectiveness of the new public transit service, it is necessary to (1) Connect it to Tren Urbano; and (2) Involve the *públicos* operators in the provision of the new service. The former will make the new system very attractive to Caguas riders because their mobility and accessibility to San Juan will be increased; in addition the service may become one of the main feeder routes of Tren Urbano. The latter is very important to ensure the success of the new system for the following reasons:

- *Competition.* Even though the current ridership from Caguas to San Juan may be the highest of all intercity travel, the demand does not appear to be large enough to support current *públicos* operation and a new service.
- *Knowledge.* Despite the poor quality of service offered by *públicos*, they have operated the service for a long time and could provide relevant operation information regarding demand, costs and rider's preferences.
- *Social and political concerns.* Despite the fact that transportation engineers do not consider *públicos* a high quality service, users may have a different perception, because they do not have any other reference system to compare with. Including current operators as an essential part of the new system, may ease the transition to the riders and reduce the social impact to the operators.

3 FINDINGS AND PROGRESS

The approach established to undertake this research project contains four major tasks:

- Literature review
- Service definition
- Design of selected service
- Conclusions and recommendations

3.1 Literature review

The literature review on the characteristics of the transport in Puerto Rico made lead to the following preliminary considerations:

- There are few literature or demand modeling studies done in the island outside the San Juan Metropolitan Area.
- Intercity trips into San Juan have increased during recent years and will keep growing. External trips into SJMA in 2010 will be 20% higher than in 1990; highways connecting Caguas and San Juan account for 43% of that growth.
- In 1990, PR-1 and PR-52 registered 103,269 vehicles on weekdays. Caguas itself generated 50,793 of these trips (Figure 2).
- The volume of traffic in PR 52 during the morning peak (From Caguas to San Juan), was 4,100 veh / hr in 1998.
- The principal public transport system available between the two cities is "*Públicos*".

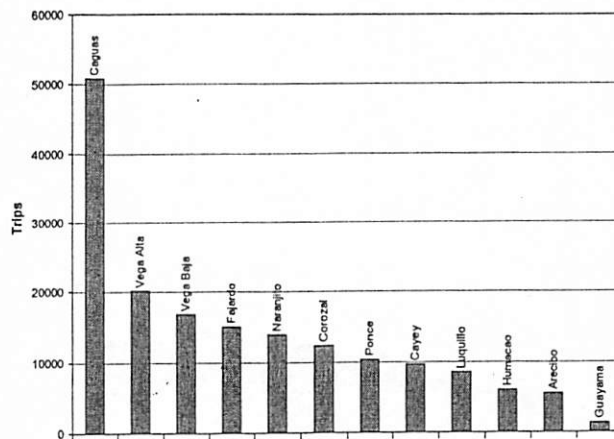


Figure 2. Weekday vehicles crossing SJMA originated in each city

3.2 Service definition

A set of alternative approaches will be explored to select the most cost-effective service between Caguas and San Juan. To define the alternatives, four minor steps are considered: 1) Definition of premises; 2) Ridership estimation; 3) Definition of major issues and their alternative solutions; and 4) Evaluation of alternatives. The last step is at this point considered into Future Work.

3.2.1 Definition of premises

Some premises were defined as guidelines for the design of the transit system:

- The design and implementation of the new system must be carried out in a period of three to five years. It should not include, for instance, construction of complex infrastructure.
- The total costs of the project (implementation and operations) must be kept low.
- Rail or similar systems are discarded and the research will focus on rubber-tire solutions.
- The new transit system should be able to provide a faster and more comfortable service than current's *públicos*.
- The new transit system should be integrated with the Tren Urbano system.
- Current *públicos* operators should be given the opportunity to participate in the new system.

3.2.2 Ridership estimation

Since almost none of the previous studies have estimated ridership between Caguas and San Juan, this research will consider ranges of possible demand instead of working with a specific demand value. The findings that give hints about possible ridership levels are:

- Current *público* routes from Caguas to San Juan have one of the highest frequencies (10 minutes in the peak hour) among intercity *público* routes.
- *Público* routes are currently served by 25-seat minibuses that transport between 18 and 22 passengers.
- During 1990, weekdays counts on an external SJMA cordon registered 111,651 crossings towards San Juan through routes PR 1, PR 52 and PR 175. This number is expected to be 131,701 in 2010, which represents a 17% increase.
- Most of the data needed to establish ridership levels will be gathered during the Encuentro in January/2001, including daily counts on *públicos* operations.

3.2.3 Definition of major issues and their alternative solutions

A set of key issues to define and analyze feasible alternatives was considered. Relevant aspects are defined as those that determine a significant percentage of the cost, the impacts and the level of service of a particular alternative. These major issues are the alignment, the terminal points, vehicles, right-of-way, and type of service.

- **Alignment.** There are three different alignments that will be considered: PR 52, PR 1 and a combination of PR 1 and PR 20.

PR 52 is the main highway connecting the two cities. It has the best infrastructure conditions, is the widest and shortest among the three highways. It arrives in San Juan directly to the Centro Medico station of Tren Urbano. PR 1 arrives into the Cupey station of Tren Urbano. Its alignment goes through more dense zones than PR 52. PR 20 is a very good highway but it only goes 5 miles out of Tren Urbano, beyond that it becomes a small road that intersects PR 1 in the point called La Muda. In case of choosing this alignment, it will be necessary to consider the construction of new infrastructure to transform this portion of the road into a highway.

- **Terminal points.** The new system will have one terminal station in Caguas and one in San Juan. A big terminal station in Caguas as a Park-and-ride, Kiss-and-Ride or Plaza facility has been initially discarded; instead a set of stations downtown Caguas will be studied.

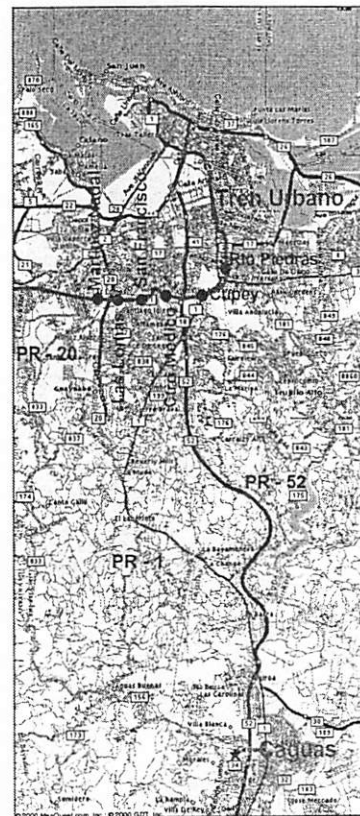


Figure 3. Caguas and Tren Urbano

Solutions involving a parking facility involve a mode transfer, large constructions and the use of autos. Conversely, routes that enter the town of Caguas and pick-up passengers directly from the street are more convenient and less expensive. The

research will further study the impacts of this decision on Caguas future land development.

As for the terminal in San Juan, two alternatives are being studied: (1) to end the new transit system at a Tren Urbano station; and (2) to go beyond Tren Urbano and end the service at other attractive destination in San Juan such as Plaza de las Americas. . In either case the system will have a stop at a Tren Urbano station to allow transfer.

An assessment will be made to determine which station is more effective. Rio Piedras and Centro Medico were chosen as the most convenient transfer stations to be included in the alternative approaches. The stations were chosen considering the following:

- ⇒ The attractiveness of the zone of the Tren Urbano station to Caguas riders
- ⇒ Convenience of transfer within the station area
- ⇒ Accessibility of the buses to the alternative Tren Urbano stations

- **Vehicles.** Preliminarily, the vehicles that appear to work best for the system are small buses. These will allow a higher frequency and more flexibility on the streets. Current vehicles could be used in the first phase of the system; therefore operators are not forced to buy new vehicles. The size of the vehicles will be validated when a ridership level is found.
- **Right-of-way.** The primary source of incentives for auto users to ride the new transit system is the reduction on travel time during peak hours. This enforces to have an exclusive right-of-way for the bus system. Given the political and social opposition to this kind of policies, an alternative approach will be studied with mixed traffic, to assess the effectiveness of the system under those conditions. The exclusive or preferential lane could be one of the existing ones on the highways or a new one could be built.
- **Type of service.** This aspect refers to a express or local system. Current operators make express trips from Caguas to San Juan. This will be evaluated and the effectiveness of stops along the route will be assessed. Determining the type of service also includes the definition of the stops/stations that will be used. These stations could vary from a sign on the road to closed station with turnstiles and pre-payment. The definition of which to use depends significantly on the demand, level of investment and technology desired.

The service frequency will also have to be determined. The current 10 minutes frequency should be regarded as lower bound for the new service. Riders will perceive a lower frequency as a decrease in the quality of service.

The preliminary four alternative approaches that have been identified are shown in the following table.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Alignment	PR 52: Higher capacity, shorter distance	PR 52: Higher capacity, shorter distance	PR 52: Higher capacity, shorter distance	PR 1: Higher density along the route
Vehicles	Buses: big for current demand levels	Buses: big for current demand levels	Minibuses: Current publico vehicles could be used	Minibuses: Current publico vehicles could be used
Right-of-way	Exclusive lane: Travel time decreases, but difficult to enforce	Mixed traffic: no travel time advantage to private cars	Mixed traffic: no travel time advantage to private cars	Mixed traffic: no travel time advantage to private cars
Terminal Caguas	Stations downtown	Stations downtown	Stations downtown	Stations downtown
Terminal San Juan	Centro Medico: high demand generator/attractor	Rio Piedras: high demand generator/attractor but difficult integration with buses	Plaza Las Americas: Possibility of capturing higher demand	Centro Medico/Rio Piedras
Service	Express/local	Express/local	Express/local	Express/local

4 FUTURE WORK

4.1 Evaluation of alternatives

After identifying each alternative a comparative assessment among them will be performed in order to select the most cost-effective one. The alternatives will be compared on their costs, impacts, effectiveness in terms of potential ridership, and ease of implementation.

The cost will be estimated for each alternative, but more important, a critical comparison between them will be performed. The monetary costs for each alternative will be evaluated as follows:

Cost = Implementation costs + Operational costs

Implementation costs = Cost of designs + Cost of land + Construction of terminals, stations, garages and depot + Equipment (control systems, turnstiles, tickets, etc) + Fleet + marketing

Operational costs = Fixed costs (wages, offices) + Variable costs (fuel, maintenance, repairs)

An analysis of the costs that could be borne by the private sector and the ones that need to be borne by the public sector will be performed.

The impacts of each alternative will be stressed. These impacts can be seen as political, environmental and social costs. Issues such as the political cost of implementing an exclusive lane, the land development incentives that each alternative provides, the environmental impact of each type of fleet, etc, will be addressed and taken into account in the evaluation. Infrastructure improvements planned by the government will also be considered as decision factors. For example, improvements in route PR-1, PR-20 extension between the sector called La Muda (PR-1) and Caguas, overpasses at PR-1 intersections with PR-173 and PR-175 and Caguas Toll plaza improvements.

Accounting for the costs and impacts of each alternative, a route service will be selected as the most cost-effective one. This will be done by choosing the service that has the highest potential level of ridership at the lower cost, under the premises and framework earlier stated.

4.2 Design of selected service

Further studies will be performed on the selected service to define in detail its main characteristics.

4.2.1 Operational

- **Timetables.** Definition of alternative timetables that could be used in order to minimize operational costs and offer high quality service to the riders.
- **Fleet.** Definition of the type of buses desired and the total fleet needed.

4.2.2 Infrastructure

- **Right-of-way.** Definition of the exact right-of-way of the service on its alignment (i.e., exclusive lanes, preferential lanes, regular flow, new road).
- **Terminals.** Location of appropriate site for terminal in Caguas, if needed, including an evaluation of the Plaza site that has already been chosen by the Tren Urbano Office in Puerto Rico. Determine the operational layout of both terminals (in San Juan and Caguas).
- **Stations.** Define location of stations along the system alignment. Determine operational layouts of the stations.
- **Depots.** Evaluate the parking areas and garages needed to operate the service, including short-term bus parking in an area close to the Tren Urbano transfer station.

4.2.3 Service provision

An evaluation will be made in terms of the potential providers for the service. The conditions under which *públicos* could provide the new service will be studied. This includes the contracting process, incentives, penalties and risks' share.

4.3 Conclusions and recommendations

Once the system has been defined, a set of conclusions and recommendations will be given regarding the feasibility of the project, the net benefit this service would bring to users and Tren Urbano, and issues that need to be addressed in order to realize the project. Areas of further research or design will be stated.

An implementation plan for the system will be written as well. It will include timetables for contracting construction and operation and if more than one route, orders in which they should be contracted to minimize transitional issues.