Public Transportation Problems and Solutions in the Historical Center of Quito

Jacob Greenstein, Louis Berger, and Amiram Strulov

Quito, the capital of Ecuador, has recently experienced a 12-percent growth in its activities, and the demand for bus transportation has increased correspondingly. In 1985–1986, this city was served by 81 bus lines. Large buses accounted for 79 percent of the fleet, and small buses accounted for 21 percent. The bus system in Quito was owned and operated by 36 different organizations, companies, and individuals. About 900 buses per hour entered the historical center of Quito. About 95 percent of the buses traveled on routes that circulated through the historical center, even though it was the destination of only about 35 percent of the bus users. In addition, bus schedules did not match the actual fluctuation in user demand, resulting in increased operating costs and time delays. Bus stops were not always in convenient or safe places, and the bus drivers did not always load and unload passengers at assigned bus stops. The bus fleet was old, the buses were usually overloaded, and travel in such conditions was uncomfortable. Finally, the planning and monitoring of route assignments were not carried out properly. The operations of the 36 bus groups were poorly coordinated, and scheduling was not sufficiently sensitive to changes in the demand for bus transportation. Among the solutions adopted were the following improvements: (a) planning and rescheduling the bus routes, (b) improving the administration and coordination of the different bus companies, (c) planning and relocating the bus stops, (d) enforcing new parking regulations, (e) eliminating such traffic hazards as the local street market, (f) scheduling more efficiently the loading and unloading of goods and merchandise, and (g) making simple improvements to the signalization and local intersections. Only simple and economic solutions were considered.

Over the last 15 to 20 years, the city of Quito, the capital of Ecuador, has grown rapidly because of migration from rural areas and natural growth. For example, the population has increased from 900,000 in 1985 to 1,200,000 in 1989. The demand for such basic urban services as transportation, water supply, sewers, education, and commerce has increased correspondingly and is still growing rapidly. Of special concern are the transportation needs in the historical center of Quito, where the quality of service has rapidly deteriorated. Because funds are limited in the current economic climate in South America, local authorities are looking for simple, practical, and economical solutions to improve the quality of public transportation. A case study has been carried out in the historical area. Although this area covers only 1 km², it is key to improving the quality of transportation for a larger part of the city. The study indicated that the main reason for poor service was the high traffic congestion and inefficient management and coordination of the local bus system.

In order to improve public transportation, the following improvements were analyzed: (a) planning and rescheduling the bus routes, (b) improving the administration and coordination of the different bus companies, (c) planning and relocating the bus stops, (d) enforcing new parking regulations, (e) eliminating such traffic hazards as the local street market, (f) scheduling more efficiently the loading and unloading of goods and merchandise, and (g) making simple improvements to the signalization and local intersections. Such improvements are economical and easy to implement and could significantly increase the reliability of the bus services and reduce the users’ costs.

Costly improvements, such as major infrastructure rehabilitation or the introduction of mass transportation systems, were not practical. These high-cost improvements take a long time to implement, and the fast growing demand for urban services might cause them to be obsolete before they were operational. A simple methodology was developed and applied to solving the urban public transport problems in the historical center of Quito.

EXISTING PUBLIC TRANSPORT SYSTEM

Quito is between two parallel mountain chains. Because of this special topography, the city developed mainly to the south and north. The historical area, where the city hall, the National Presidential Oval, the court system, and other public buildings are located, is in the middle of the city. Quito’s cultural, commercial, and administrative services are concentrated in this center. These services attract heavy public and private traffic into the center, most of which enters and exits through two major streets (Guayaquil and Maldonado), creating the principal corridor shown in Figure 1. Figure 1 indicates the principal road network and the upper limit of the hourly intensity of buses, as determined in 1982. For example, in that year 204 buses traveled along Maldonado Street each hour in each direction. Along Guayaquil Street, the volume was 196 northbound and 151 southbound. During 1984 and 1985, the traffic volume increased by approximately 10 percent. Maldonado and Guayaquil Streets are connected to the local road network by at-grade intersections. The local streets in the historical center form a dense network with an average distance of 50 to 80 m between intersections. The streets are narrow, with sharp curves. Because parking space is limited,
illegal parking is common, causing traffic congestion and hazards.

The case study indicated that bus service did not meet the actual fluctuation in demand. In 1984 and 1985, the bus fleet in Quito included 2,031 buses, operated by 36 different owners with limited coordination; most of the buses were overloaded. The total vehicle fleet of Quito was over 100,000 at that time. The bus fleet comprised 477 large buses, 1,204 medium-sized buses (known as colectivos), and 350 small buses (or minibuses). The large and medium-sized buses, which have 42 and 30 seats, respectively, have already been in service for 13 to 14 years. The small buses, with 22 seats, averaged 6 years of age.

The bus system serves 81 routes in the metropolitan area. The lengths of the routes vary between 15 and 30 km, with an average length of 24 km. At the time of the study, about 95 percent of the routes entered the historical center. This concentration of bus routes is indicated in Figure 1. Along Guayaquil Street, 11 routes are in operation; one of these is Route 10, which is analyzed in a following section. The traffic survey showed that buses entered the district at a rate of 900 per hour, contributing to a high concentration of traffic in an area of only 1 km². Bus traffic (in 1984 and 1985) was 13.9 percent of the total traffic volume. Private cars, taxis, and commercial vehicles represented 53.2, 19.9, and 13 percent, respectively, of the total hourly traffic volume entering the historical center. The high traffic volume resulted in traffic congestion, negative environment impact from air and noise pollution, traffic hazards, and high user costs. Figure 2 shows a typical picture of traffic congestion in the historical center during rush hour and the main street of Maldonado during offpeak hours. The origin-destination (O-D) survey indicated that the number of buses outside the historical center was too low and did not match the actual local demand. The following conclusions were drawn from the performance analysis of the bus system in Quito:

- Bus schedules did not match the fluctuation in users' demand and caused increased operating costs and time delays. Assignment or scheduling was frequently changed with little or no coordination with other bus companies.

- Bus stops were not always in convenient or safe places, and bus drivers did not always load and unload passengers at assigned bus stops. This kind of operation increased traffic hazards and the number of bus stops, as well as travel times and operating costs.

- The bus fleet in Quito was old. Most of the buses had only one door for both entrance and exit and could not provide comfortable, safe, and economic service.

- The planning and monitoring of route assignments were not carried out properly. The operations among the 36 bus companies were poorly coordinated, and scheduling was not sufficiently sensitive to changes in the demand for bus transportation.

**PUBLIC TRANSPORTATION SURVEY**

A bus transportation survey was carried out in Quito in 1984 and 1985. The main purposes of this study were (a) to determine the demand for bus use in the entire metropolitan area, especially in the historical center; (b) to determine the relationship between the demand and the capacity of each route; and (c) to improve the operation and administration of the bus services. For the purposes of this survey, Quito was divided into 13 zones, and for each zone the following information was analyzed: number of bus users, number of trips per person per day, purpose of each trip, origin and destination (O-D) of each trip, number and location of bus transfers for each O-D, need for improvements in scheduling level of service, and the like.

The conclusions of this survey concerning the demand for bus service in Quito are shown in Figure 3. Demand is defined in terms of the number of passengers traveling by bus through the historical center. Figure 3 shows that the daily number of passengers traveling by bus through the historical center was approximately 800,000 to 900,000, using 90 percent of the available bus fleet. However, only 280,000 passengers wanted to go there. In other words, about 65 percent of the passengers traveled through the center needlessly. To verify this conclusion, an additional and special O-D survey was carried out at bus stops only. For each passenger trip, the first and last
stop were determined along with such factors as the actual bus route used, other possible routes, and the location of and need for bus transfer. The conclusions of this survey verified the previous one and indicated that (a) most of the bus transfers took place inside the historical center, (b) 65 percent of the passengers were unnecessarily routed through the center, (c) most of the passengers believed that the center was practically the only place to find a bus transfer, and (d) most of the bus routes between various O-D zones passed through the center. To complete the Quito study, a passenger count survey was carried out at representative bus stops. This survey indicated a low occupancy rate for local buses. During offpeak hours, occupancy dropped to an average of 40 to 50 percent on the busiest routes. This conclusion was confirmed by means of the revenue analysis and ticket sales.

**IMPROVEMENT IN BUS OPERATION**

The conclusions of the demand analysis were used to optimize the planning and rescheduling of the bus system. For example, Route 10 was divided into two routes, both having the same O-D. One route crossed the historical center, but the second bypassed it. Similar procedures were used to improve other routes. The result of the implementation of the new program was a 40- to 50-percent reduction in the number of buses traveling into the historical center. Travel time through the center was reduced, on average, from 10 to 8.5 min after the Route 10 change. Another improvement for meeting the fluctuation in demand optimized the use of different sizes of buses. For example, during the morning rush hour (between 7:30 and 8:30 a.m.), 25 small, 20 medium-sized, and 15 large buses were used to provide service to 1,000 passengers. These 60 buses had a capacity of 1,580 passengers. After the reorganization, 8 small, 13 medium-sized, and 10 large buses were used to serve the same number of passengers. An effort was made to maximize the use of larger buses and thus reduce the total number of buses needed to enter the historical center. After the reorganization, 31 buses could provide the service previously provided by 60.

In order to better manage the new bus planning program, a simple management information system (MIS) was developed. This MIS is now used to collect and evaluate data and to optimize the scheduling and planning of bus operations. It permits fast access to such information as the number of bus tickets sold; actual number of buses in service; rate of occupancy, mileage, and fuel consumption; and the maintenance record for each bus. The information stored in the MIS was found to be useful in predicting the fluctuation in future demand for bus services. For example, the MIS program will adjust the schedule and assignment of the bus fleet to meet the demand during an important event, such as the opening of a new school year, a sports event, or a special public ceremony. By means of the new organization, coordination, and operation of the bus industry, it was possible to reduce by 40 to 50 percent the number of buses entering the historical center. The impact of this reduction was a savings of about one-fifth of the fleet for the metropolitan area, contributing to a reduction of operating costs and permitting the use of these buses to improve other public transportation needs of Ecuador, such as those of the rural areas outside Quito.
FIGURE 3 Sample demands of bus passengers in Quito.

SOcioECONOMIC ANALYSIS

The socioeconomic benefits of an improvement in bus service can be measured in terms of an increase in passenger comfort, a reduction in the number and severity of accidents, and a reduction in user costs and traveling time. The 1984–1985 value of the used 2,031-vehicle bus fleet in Quito was approximately $40 million (all values in U.S. dollars). The value of a new bus fleet would be $200 million. Because one-fifth of the present fleet was saved for other uses, the economic value of this benefit could be set at $8 million.

Another economic benefit was obtained from the reduction of travel time inside the historical center from 10 to 6 min. This time reduction translated to an hourly savings of 60 bus-hours during the peak hour or a daily saving of 600 bus-hours, equivalent to a daily savings of approximately $3,600 or an annual savings of $1.3 million. This benefit is related only to the reduction of bus operating costs; it does not include the value of passenger time savings. These savings were estimated at 4,000 work-hours per day, or an annual savings of approximately $1.2 million. It was also found that because of the improvement in the bus service and its reliability, the daily number of users traveling into the historical center increased by 80,000 persons (approximately 10 percent of the total daily number of passengers). In other words, the bus service became more attractive to the public after the reorganization.

After the reorganization, the administrative costs were reduced by an estimated $250,000 per year. These savings were obtained by using the MIS program, which permitted a reduction in the labor needed for supervision, control, and monitoring. The total annual cost savings of the bus transportation industry was estimated in 1985 at $10 to $11 million, or approximately 25 percent of the present value of Quito’s bus fleet.

SUMMARY AND CONCLUSIONS

The bus fleet in Quito was owned and operated by 36 different organizations, companies, and individuals. The total number of buses in 1984 and 1985 was 2,031, most of which were overused. Of this fleet, 477 were large (42 seats), 1,204 were medium-sized (30 seats), and 350 were small (22 seats). This bus system served 81 routes in the metropolitan area, and 95 percent of the routes crossed the historical center of the city.

The area of the historical center is 1 km², and a traffic study indicated that 900 buses per hour were entering the district, resulting in high traffic congestion, air and noise pollution, traffic hazards, and high user costs.

The Quito study indicated the following deficiencies in bus service: bus schedules did not meet the actual fluctuation in passenger demand, bus stops were not always in convenient or safe places, and the planning and monitoring of route assignments were not carried out properly.

The daily number of passengers traveling by bus through the historical center was 800,000 to 900,000, using 95 percent of the city’s available bus fleet. Nevertheless, only 280,000 passengers actually wanted to go to the area. In other words, about 65 percent of the passengers were forced to travel through the center to other destinations.

A new planning and bus scheduling program was implemented to improve the quality of bus service. The result of this program was a 40- to 50-percent reduction in the number of buses traveling into the historical center. Another operational improvement in matching the fluctuation in demand was obtained by optimizing the use of different sizes of buses. The use of fewer and larger buses reduced both volume of traffic and travel time. Reducing and relocating the bus stops also reduced travel time. After the implementation of the new planning and operation program, travel time was reduced.
from 10 to 6 min, and the probability of a bus arriving on schedule, plus or minus 2 min, was increased from 30 percent to 75 percent.

The reduction of travel time and the improvement of bus services increased ridership in the central district by approximately 10 percent. No significant change in ridership was observed outside the historical center during the 1 to 2 years of traffic monitoring.

The implementation of the new bus planning program was aided by enforcing new traffic and parking regulations. Merchandising was removed from main streets, and bus lanes were established. The parking system was reorganized, and a new system of tariffs and time limits was enforced.

The socioeconomic benefits of the improvement in bus service were measured in terms of increased passenger comfort, reduction in the number and severity of accidents, and reduction of operating costs. The value of Quito's bus fleet in 1984 and 1985 was approximately $40 million. It was estimated that approximately 25 percent of this value was saved by implementing the new bus planning and operating program.

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