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Latin American Busways:

Moving People Rather than Cars

by

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Abstract

The rapid growth of Latin America urban centres beginning in the 1970s placed a heavy strain upon urban transport service providers. Facing high population growth from a citizenry dependent upon public transport and having limited financial resources to develop car-based infrastructure, Latin American municipal planners were challenged to create a new transport paradigm. One ingenious response to this dilemma was the busway, a surface metro system that utilizes exclusive right-of-way bus lanes. The developers of the Latin American busways astutely observed that the ultimate objective was to swiftly, efficiently, and cost-effectively move people rather than cars.

Examples of innovative busway systems are presented from Curitiba, Bogota, Porto Alegre, Quito, and Sao Paulo. The low cost, flexibility, and speed of the exclusive busways all contribute to extremely high levels of customer satisfaction. Innovative approaches to the design of busway loading stations and simplified ticketing have also helped to reduce operating costs and improve customer flows. Additionally, clear system maps, colour-coded routing, system safety and cleanliness, and superior customer service have helped direct consumer preference towards the busway. The success of busways has also proved that costly subway systems or uncontrolled sprawl are not the only options available to municipal planners.

The Latin American busway corridors provide high peak capacities that permit busway corridors to serve the transit requirements of most medium to large-sized cities. When integrated with progressive land-use policies, busways can also form the basis of more sustainable urban design by encouraging development corridors with high-density, mixed-use land use. The environmental benefits and calming influences afforded cities by busway systems have translated into dramatically improved levels of quality of life indicators, including improvements in health, crime reduction, and poverty alleviation. The user-friendliness and cost-effectiveness of busway systems have convinced municipal leaders in North America, Europe, and Australia to develop similar systems of their own. Latin American busways thus provide a unique example of South to North technology transfer.

Keywords
Busways, bus rapid transit, Latin American transport and sustainable transport.

1. Introduction

Innovation's inspiration can arrive from unexpected sources. For Latin American cities faced with extreme transport and environmental imperatives, necessity has proved to be a highly motivating force towards delivering cost-effective public transport services. In the past several decades, the financial limitations facing many Latin American municipalities have spurred creative solutions to urban transport problems that have long threatened to undermine public health and economic growth. Latin America's response to this challenge is one that can offer practical help to congested cities elsewhere, including cities in highly industrialized nations.

The rural to urban population shift that affected Latin America's urban centres in the 1970s placed a heavy strain upon urban transport service providers (UNCHS, 1996). Facing high population growth from a citizenry dependent upon public transport and with limited financial resources to develop car-based infrastructure, Latin American municipal planners were challenged to create a new transport paradigm. One ingenious response to this dilemma was the busway, a surface metro system that utilizes exclusive right-of-way bus lanes. The developers of busway systems astutely observed that the ultimate objective was to swiftly, efficiently, and cost-effectively move people rather than cars.

2. 16th Century design, 21st Century traffic

The traditional structure of Latin American cities owes its origins to Spanish and Portuguese design principles of the 15th and 16th centuries. The historical cores of Latin American cities feature narrow cobble-stoned lanes that are more suitable to strolling tourists than the demands of automobiles. Unfortunately, private car ownership in Latin America has leapt ahead of supporting infrastructure (see Figure 1). Latin America is now home to urbanization rates of up to 80% and vehicle ownership rates three times that of Asia (excluding Japan) and four times that of Africa, averaging about 90 vehicles per 1000 people in 1990 (World Bank, 1997). With GDP levels in many

Fig. 1. The rapid growth in automobile ownership in Latin America has stretched the capacity of urban road infrastructure to its limits.

Latin American countries now exceeding $3000 per capita, automobile purchases are taking off at an accelerated pace. From 1970 to 1990, the Latin American vehicle fleet grew by about 250%, reaching 37 million vehicles (World Bank, 1997). Unfortunately, much of this growth consists of older, used vehicles imported from nations where their useful lives are long past. Emissions from such older vehicles are several times greater than those of newer models due to outdated technologies, neglect, and improper maintenance.

In Mexico City, where breathing the air is equivalent to smoking two packs of cigarettes per day, an estimated 6,400 premature deaths occur per year due to vehicle emissions (Bartone *et al*., 1994). An estimated 29% of children currently have recorded unhealthy levels of lead in their blood. Likewise, the extreme levels of air contaminants in Sao Paulo and Santiago have routinely forced closings of schools and outdoor activities. The added health costs from congestion and elevated contaminant levels are a price

few cities in Latin America are capable of bearing without a significant economic penalty.

The air quality and health problems are not limited to just mega-cities, such as Mexico City, Sao Paulo, Rio de Janeiro, Santiago, and Buenos Aires. Cities perched upon the northern Andes, such as Bogota (Colombia), Quito (Ecuador), and La Paz (Bolivia) suffer contaminant levels well above standards set by the World Health Organization, especially with regard to carbon monoxide and particulate matter. Due to climatic factors and altitudes ranging from 2500 to 4000 meters above sea level, these cities are particularly susceptible to elevated pollution levels. Petrol and diesel fuels do not burn effectively at such altitudes and leave high levels of unburned contaminants. Thus, as residents must breathe in more air to receive an adequate oxygen supply, they are also absorbing more contaminants. This leads to increased rates of respiratory illness and medical costs.

An additional economic price is paid in terms of lost productivity in moving goods and people in a very inefficient manner. The World Bank recently calculated that the equivalent of 2% of Colombia's GDP is spent moving people and goods chaotically within Bogota. While the narrow walkways and colourful, adobe-styled structures that line Latin American historical centres may be effective in attracting tourists, such urban designs are also quite adept at entrapping pollutants within the city. The daily bombardment of heavy traffic is also beginning to undermine the structural integrity of many historical sites that have withstood the test of time for five centuries. According to municipal officials in places listed among UNESCO's World Heritage sites, such as Quito, Cuenca (Ecuador), Salvador (Brazil), and Olinda (Brazil), as well as the historical cores of Bogota, Lima, and Santiago, the degrading environment can greatly harm the prospects for badly needed tourism revenues. A 1999 study in Quito showed that the health and loss of productivity costs alone resulted in a US$27 million economic loss to the city (Jurado and Southgate, 1999). Traffic congestion alone is estimated to cost Lima, Peru $210 million each year (Iterrugui, 1996). A broader study of total internal

and external costs in Santiago, Chile indicates that "transportation costs residents $5.7 billion, or approximately 27.5% of Gross Regional Product" (Zegras, 1997).

Perhaps most affected by Latin America's spiraling car-ownership levels are the segments of society with the fewest options to protect themselves against the growing tide of pollution. Informal workers ply their trades and goods along Latin America's busiest streets in order to remain a small step ahead of absolute poverty (see Figure 2). Many work 12-16 hour days only a breath away from tailpipes emitting particulates, carbon monoxide, and nitrogen oxides at levels well beyond the maximum recommended by the WHO.

Fig. 2. Children and the poor work long hours in the streets of Latin America, only a breadth away from highly polluting tailpipes.

Further, with spiraling consumer prices resulting from economic structural adjustment, transportation has become a significant cost item for Latin American households. Often confined to informal settlements at the periphery, low-income urban dwellers are now spending up to 40% of their income and a third of their long working day trying to access markets, services, or informal economic opportunities in the city centres. In Sao

Paulo, the typical commuter from a poor area of the city spends more than two hours per day traveling (Thomson, 1994). And what do they receive in terms of service and efficiency for that significant investment in money and time? The private sector firms that largely provide transport services in Latin American cities must do so under severe economic pressures. Thus, the long commute into the city becomes an uncomfortable and at times perilous journey that only further exacerbates tensions, stress, and a diminished quality of life.

3. The busway, made in Latin America

The rapid urban population growth and limited municipal resources during the 1970s severely stretched the ability of Latin American municipalities to deliver effective transport services. In some cases, the sector was virtually abandoned by the public domain, and thus left to paratransit and other private sector means. The result was an uneven and often chaotic mix of options that rarely served the urban transit customer. Private buses operated like taxis and fought aggressively for routes without the aid of central coordination and organization. In many Latin American cities, this situation is still the norm today.

A city in the south of Brazil, though, took a different direction and in the process has redefined sustainable urban design for both the developed and developing world. Curitiba, Brazil with a determined civic leadership and a team of innovative planners and urban design professionals set about to find a solution to the Latin American transport dilemma. As early as 1965, the municipality laid out a visionary Master Plan that placed sustained quality of life at the forefront. With a population that jumped from approximately 400,000 inhabitants in the 1960s to over 2 million today, Curitiba has been pressed by social issues on several fronts including housing, sanitation, and employment (Rabinovitch and Leitmann, 1993). The lack of financial resources for an underground metro system meant that more creative solutions were required. Thus, the idea of recreating the rapidity and convenience of an underground system on the city's

surface emerged. The municipality developed its first express bus lanes in 1974 and has continued to expand the system to this day. The later introduction of boarding tubes that emulate the comfort and security of subway stations as well as the procurement of 270 passenger bi-articulated buses earn the system the nametag of "surface subway" (see Figure 3).

Fig. 3. With its efficient station design and high-capacity buses, Curitiba has revolutionized the way in which municipalities around the world view public transport.

Today, Curitiba's bus system is utilized by 75% of all commuters despite the fact that Curitiba possesses one of the highest car ownership rates in Brazil. In total, the city's network includes 58 km of express bus lanes, 270 km of feeder routes, and 185 km of interdistrict routes; the systems serves over 1.9 million passenger trips each day (City of Curitiba, 2000). Curitiba's innovations have since inspired countless case studies and study tours looking to probe the city's success across an array of environmental and social issues. While former Mayor and motivating force Jaime Lerner modestly calls

Curitiba merely a "point of reference," the city has greatly helped redefine creativity in the context of municipal government and transport.

During the early to mid-1990s several other Latin American cities took note of Curitiba's lessons, and many such municipalities developed busway designs of their own. Today, busways can be found in Quito (Ecuador) and the Brazilian cities of Porto Alegre, Goiania, Recife, Belo Horizonte, and Sao Paulo. Bogota has mostly recently launched its *Transmilenio* Project which aims to construct over 41 km of busways in its initial phase, and eventually locate a busway station within reach of 85% of the city's population.

Quito, Ecuador's trolley-bus system and recent *Eco-Via* addition are dramatic examples of busway cost-effectiveness and the applicability of busways even under stressed economic conditions. Ecuador has experienced several tumultuous years of political and economic misfortune. In 1998, rains from the El Niño climatic effect destroyed much of the nation's infrastructure. Then, in 1999, on the heels of the emerging global market crisis, Ecuador's banking sector virtually collapsed. The previous two governmental administrations have survived only one to two years in office. However, in the midst of this rather chaotic scene, Quito has developed and expanded an impressive transit system featuring 25 km of exclusive busways.

Quito's existing fleet of privately run buses has taken an environmental and health toll on the city. Until recently, the average bus age of the private sector fleet has been 17 years, with some units as old as 35 years. These buses are typically 30% louder than international norms, and in recent emission tests, fewer than half of the private sector buses can pass minimum opacity requirements (Arias and Wright, 1999). Thus, the trolley-bus system has provided vital relief on the environmental side. The electric trolley-bus also delivers additional environmental gains through the substitution of diesel-fuelled buses with units powered by hydro-generated electricity. The overwhelming popularity of the Quito trolley-bus has exceeded expectations and in a sense created an unexpected problem. With over 200,000 commuters now using the

system daily, its maximum capacity has been virtually reached, and thus has prompted calls for further expansion.

While both Curitiba and Quito are moderately-sized cities at approximately two million inhabitants each, the next test for the busway concept is being attempted in the larger metropolis of Bogota, Colombia. With a population of nearly 7 million dispersed across a wide, high-altitude valley, Bogota is a certain transport planning challenge. Colombia is in the midst of a great national upheaval, as government forces, guerrillas, and para-militaries are involved in daily skirmishes that threaten the country's stability and future. Over 2000 citizens are taken hostage each year as part of this conflict. In addition, the nation is facing serious economic difficulties with unemployment now over 20%.

Fig. 4. Bogota's vision for a sustainable transport future. Illustration courtesy of the municipality of Bogota, Institute for Urban Development.

In the midst of this struggle, Mayor Enrique Penalosa has set forth a bold plan to revolutionize Bogota's frantic transport scene. The plan calls for extensive cycle-ways, traffic calming measures, and approximately 41 km of exclusive busways (see Figure 4). While some have criticized the Mayor's plans as being irrelevant and distracting at a time of civil strife and deep economic troubles, Penalosa sees the sustainable transport vision as key to achieving greater equity and peace in the troubled nation. By prioritizing public transport investment over car-based infrastructure, the mayor hopes to guarantee better access for Bogota's most disadvantaged citizens.

Bogota's initial 41 km of exclusive bus lanes on three different routes is only the beginning. The municipality's vision for the busway system, known as *Transmilenio*, is to one day cover the entirety of Bogota's vast urban area, and place 85% of the population within 500 meters of a busway station. Bogota's buses will also be amongst the lowest-emitting in the region, due to strict emission standards for the private firms wishing to bid as bus service providers. These standards are expected to reduce emissions by 80% compared to the existing private fleets utilized in the city today (Rodriguez, 2000).

Fig. 5. Bogota's extensive network of cycle ways has helped to position the city to become car-free by the year 2015.

Integration of busways with non-motorized transport options such as cycle routes and car-free zones are mutually beneficial to all transport options. Bogota's busway system will be well coordinated with the city's additional plans for some 300 km of cycle-ways. The busway stations will provide infrastructure for bicycle parking in order to integrate

pubic transport and non-motorized modes. Bogota has long supported "car-free Sundays" along the city's principal traffic corridors, and in February 2000 conducted an experiment to go car-free throughout the wider metropolitan area. A daring referendum placed before the voters in October 2000 has now taken the car-free concept a leap ahead. Voters approved a permanent car-free day each year (see Figure 5). More dramatically, the voters also approved making the entirety of Bogota car-free every day by the year 2015, the year when Transmilenio will be fully completed. The car-free referendum stipulates that only non-motorized and public transport modes will be allowed to operate during the three-hour peak period in the morning and the three-hour peak period in the late afternoon. Curitiba has likewise integrated its busway system with a large pedestrian zone in the city centre as well as 150 km of cycling routes.

A close relationship actually exists between the development of an efficient public transport system and the effectiveness of non-motorized options such as pedestrian zones and cycle ways (see Figure 6). High public transport use reduces the

Fig. 6. Quality of life: Curitiba's car-free pedestrian zone is a natural complement to the city's extensive busway system.

The Latin American busways also demonstrate the value of integrating land-use planning with transportation strategies. Busways can play a catalyzing role towards sustained economic development. For example, the busway stations in Curitiba are development nodes which act to attract commercial and residential development. In fact, the busway routes and development nodes are mutually beneficial. The strategic siting of busway stations improves customer access to shopping, employment, and services while the high-density centres ensure sufficient passenger traffic to maintain cost-effective busway operations. Curitiba has also coordinated new residential construction around bus arteries. The end result is that the municipality can deliver basic infrastructure such as water, sewage, and electricity at a significant cost savings to the concentrated and coordinated areas of development. While mixed use, high density planning does not always guarantee a sustainable urban environment, as many Asian cities demonstrate, integrated planning efforts between land use and transport can provide a win-win situation for municipal officials, commercial developers, and residents.

4. Designing for people not machines

Prior to Curitiba's ideas with boarding tubes and user-friendly features, bus systems worldwide have often lacked a customer-friendly orientation. Unclear schedules, unclean buses, and uncomfortable rides were all too frequently the obligatory price to be paid for utilizing public transport. Such a predilection, though, can lead to a downward spiral, in which poor services push more commuters toward single-occupant car use. In turn, the reduced ridership curtails public transport revenues and further diminishes quality of services which again leads to a further erosion of the passenger base.

Latin American busway systems such as those in Curitiba, Quito, and Bogota, though, have implemented design and service features long considered only to be the domain of

Fig. 7. The rapidity of exclusive bus lanes makes busways the most time-efficient option for commuters.

more luxurious underground systems. Exclusive bus lanes, rapid boarding and alighting, secure and comfortable stations, colour-coded routes, widely displayed system maps, simplified ticketing, and sophisticated marketing identities have all transformed the way transport and planning professionals view today's municipal bus systems. While these design and service features have helped to make dramatic improvements in system effectiveness and customer satisfaction, each is relatively low-cost to implement and relatively low-tech in nature. Thus, another lesson from the Latin American busways is that simple, ingenious, low-technology solutions are often of much greater value than more complex and costly alternatives.

The rapidity of exclusive bus lanes has helped cities like Curitiba and Quito attract significant public ridership from even the car-owning sectors of the population. The sight of a bus flowing smoothly by as one sits in anxiety-laden traffic is perhaps the best marketing tool for busway operators (see Figure 7). Busways can carve out significant

time savings for virtually all commuters, regardless of the alternative transport option. Curitiba's express buses save the commuter an average of 34 minutes at peak times. In addition, with the right design, waiting areas and the buses themselves can provide riders with a calm environment to undertake value-adding activities such as reading or studying, and thus add further advantages over automobile use.

The bi-articulated buses, such as those utilized in Curitiba, have three wide doorways for boarding and alighting as well as entry ramps that flip down to ease entry and departure. Studies show that over 20% of travel time may be spent waiting during boarding and alighting (FTA, 2000), and thus efforts to reduce this unproductive time can have significant benefits. Simplified fare payment systems can also reduce travel time and increase customer satisfaction.

Curitiba and Quito both utilize one-fare systems in which the fare price is the same regardless of the distance traveled. In the case of Latin American cities, such a practice not only simplifies customer understanding of the system but also serves social equity goals. Many low-income residents live in the periphery of Latin American cities, and thus are often disadvantaged by relatively high travel costs to reach economic opportunities within the city core. Fare payment is further refined by the practice of off-vehicle payment. Within the enclosed station platforms of Quito and Curitiba, pre-pay fare systems permit entry in a clear and efficient manner. This practice thus eliminates the passenger queuing and delays that often occur when payment is made inside the bus.

The attractive, enclosed station platforms are another busway innovation that was previously only utilized by underground and rail systems. From the customer's standpoint, the stations offer a waiting sanctuary that reduces stress, inconvenience, and threats to personal security (see Figure 8). In Quito, where the climate varies from strong equatorial sun to torrential rains, the enclosed stations can be a necessary protector from the elements. With transit staff operating each station, security concerns that typically accompany use of public transport use are clearly eased. In fact, with the

rash of car abductions now plaguing much of Latin America, busway use has suddenly become the safest option. The seating and pubic telephones provided in the stations are also additional examples of client-focused design that helps the customer make use of waiting periods. In Quito, video screens in the stations provide public transport users with news and entertainment.

Fig. 8. Bogota's vision for secure and pleasant loading stations helps build customer confidence in the *Transmilenio* system. Photo courtesy of the Municipality of Bogota, *Transmilenio*.

Station design and planning are also important to effective busway integration with other feeder and inter-district bus services. In Bogota, Curitiba, and Quito, the exclusive busway systems are all connected via special transit stations, typically at the ends of the busway lines, to feeder services that deliver customers to outlying areas. More importantly, these well-designed transfer points permit passengers to move 'fare-free'

between the two systems. Thus, passengers avoid the time loss and added costs of exiting and entering separated stations and systems.

Customer confidence and interest has been further bolstered by improved marketing and information practices. Historically, the ad hoc and paratransit systems in many Latin American cities followed informal and uncontrolled routings that required a seasoned system insider to fully understand and utilize. Many such systems were incomprehensible and formed a formidable barrier to potential new users, those with occasional transport needs, and temporary visitors to the city. The busways of Bogota and Quito have again emulated the better underground systems of the world by providing clear system maps both at stations and on-board buses. Colour-coding schemes are also used in some systems to allow customers to readily differentiate between multiple routes.

The presence of friendly transit staff at stations also helps to overcome any customer uncertainties. Providing this staff with smartly-styled uniforms helps raise the public's perception of system quality and professionalism. Strict daily cleaning and maintenance practices keep the stations and buses relatively immaculate, and thus again reinforce consumer confidence in the system. Exceptional cleanliness can also be a determining factor in dissuading problems of crime and graffiti. Individually, each one of these features may appear to be insignificant measures, but their combined effect has resulted in extremely high levels of customer satisfaction and impressive market penetration for the busway systems.

5. Innovative financing

While busway designers have emulated many design features from subway systems, they have not, fortunately, inherited the price tag that goes along with going underground. Without the significant excavation and equipment costs of underground systems, the surface busways are realistically achievable within the budgets and

financing capabilities of Latin American cities. Nevertheless, for many of these municipalities, financing transport infrastructure is always a challenge, and thus Latin American cities have employed as much creativity on financing as they have on system design.

The lure of constructing underground systems is too often derived from perceived status rather objective financial analysis. Subways, while clearly relevant to densely populated areas with little room for surface infrastructure, are probably not the definitive solution for most cities. At $90 million to $100 million/km constructed (Rabinovitch and Leitmann, 1993), underground systems can present unrealistic financial demands on cash-strapped cities in developing nations. Alternatively, the Latin American busways have been delivered at costs ranging from $1 to $3 million/km (TCRP, 1999). Thus, a busway network can cover as much as 100 times a city's area at the same cost as a subway (see Figure 9). The lower cost of busway systems may have significant ramifications for cities with populations under one million inhabitants. Such secondary cities have traditionally not been financially able to develop highly integrated systems that adequately cover their area. The busway, or at least many of its low-cost design features, are within reach even for smaller metropolitan areas, depending upon city densities and routing options.

Ironically, cities such as Curitiba and Quito first examined the underground option. Fortunately, the unavailability of financing forced a more realistic examination of the busway option. Many cities in developed nations, though, are capable of financing subways, and thus have perhaps been led down a less effective path due to their inherent financial strength. Comparing operating costs between subways and busways also shows the fortuitous decision of Latin American cities to pursue the busway. Only two underground systems in the world are reportedly recovering costs through fare-box collection, Sao Paulo and Hong Kong (TCRP, 1999). The Quito trolley-bus which charges a modest fare of $0.15 is able to fully cover all operating expenses.

The relatively low fare of the Quito trolley-bus also permits access to the system for most economic segments of the population. Some underground systems and above-ground rail systems, such as Bangkok's new Skytrain, have come under criticism for fares that exclude less advantaged segments of society. At $0.80 to $1.60 per trip, the

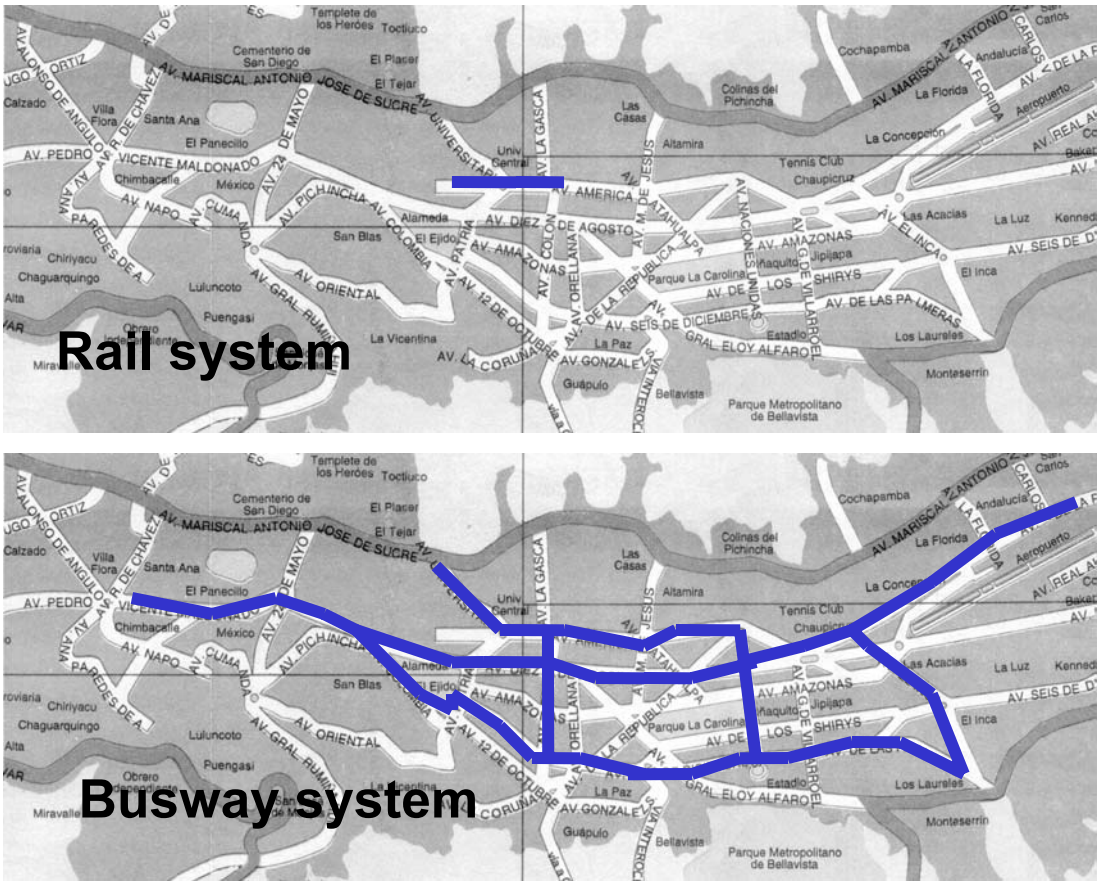

Fig. 9. Value for the money: The top map illustrates a theoretical rail system; the lower map illustrates a busway system costing the same amount.

Skytrain is not an option for much of Bangkok's poor. In turn, a sort of transit apartheid is created, where subsidized state-of-the-art technology whisks the wealthier segments of society about the city in comfort while the poor are relegated to the rigors of under-invested surface transport. By comparison, the relatively low-cost, one-fare system that applies to the entire urban area of Curitiba means that the average commuter only spends about 10% of personal income on transport (Birk and Zegras, 1993).

Even with the lower comparative costs of busways, cities such as Curitiba and Quito have struggled to finance their ambitious plans. For many municipalities in developing nations, local commercial banks lack sufficient capital reserves, while international institutions are reluctant due to risk and credit-worthiness concerns. Additionally, national government decentralization efforts are now sweeping through much of Latin America, leaving municipal governments with greater autonomy and responsibility. Unfortunately, in most cases, financial resources have not accompanied the added responsibilities.

Quito's first 11.2 km of the trolley-bus system were completed for a relatively modest investment of $57 million, partially financed with loans from the Government of Spain and partially from local sources (Arias and Wright, 1999). Bogota is investing some $280 million in an initial 41 km system; the costs include upgrading roadways as exclusive bus lanes, stations, maintenance and parking facilities, and exchange areas to handle system integration with feeder routes (Rodriguez, 2000). In Bogota's case, this investment, which excludes the actual buses, is primarily derived from local municipal funding.

Given the local financing constraints of such cities, though, creative partnerships with the private sector have been sought when feasible and appropriate. In the case of Curitiba's bus system, Quito's Eco-Via, and Bogota's Transmilenio Project, private operators largely supply the buses and manage day-to-day operations. The municipality or a quasi-governmental entity typically sets the standards in terms of emission limits, bus types, and overall performance. Revenues are pooled and then distributed to the different private operators on a distance traveled basis. The overriding principal is to leverage private sector capital investment whenever possible, but leaving decisions relating to design and quality standards with the municipality. In Bogota, the private operators will be investing a total of $68 million to provide the new buses for Transmilenio (Rodriguez, 2000). Quito has worked with private bus operators to form a cooperative called TRANASOC that will be providing the actual buses and service on

the new Eco-Via line. The Quito cooperative is currently seeking nearly $9 million in funding for the 42 articulated buses required on the Eco-Via line (Nuñez, H., 2000).

Partnerships with the private sector not only help leverage badly needed capital, but also help defuse potential social conflict due to competition between the private and public systems. The results to date across Latin America show overwhelming customer satisfaction with the busway systems. Research by the City of Curitiba shows that 89% of users express a high level of satisfaction (City of Curitiba, 2000). In cities such as Quito, independent private operators and public busway systems still co-exist. As the busway systems continue to expand and grow in customer preference, private operators are finding themselves marginalized to the point of leaving the market. By bringing private operators into the newly developed busway systems, the municipality is avoiding the social disruption that might otherwise occur from lost employment and business failure.

The greater design flexibility of busways also means that future system changes and expansion are also more financially feasible. The relatively fixed nature of underground infrastructure leaves few options to adjust to demographic changes in the urban area. The evolutionary growth of the Curitiba busway system demonstrates how adaptable busways are to urban growth dynamics. Starting with just two bus lanes in 1974, the city now boasts five express busways as well as plans for a circular ring route that will allow passengers to travel between points without entering the city centre. The flexibility to grow and adjust to new customer demands means that city officials are not indefinitely beholden to past assumptions and planning choices. Finally, busway systems also enjoy reduced maintenance costs as compared with conventional bus systems. The dedicated lines and fixed stations make for smoother operations as it allows the busways to avoid the perils of competing for road space and congested traffic that plagues conventional systems.

In many respects, busways borrow key design features from underground systems, but these borrowed features are not the expensive aspects. The largest costs associated

with underground systems are excavation and system equipment costs. The design features such as maps, colour-coding, one-fare ticketing, and transfer ease are actually relatively low-cost items. Somewhere along the line, a perception developed that assumed surface bus systems were in some way undeserving of even this minimum investment. The Latin American busways have changed that perception and have reinvented bus systems with a new bias towards customer service.

Unfortunately, many municipalities are still plunging ahead with ill-conceived plans for highly-indebted and highly-subsidized Metro systems. The Brazilian government is funding a rash of light rail construction in such cities as Brasilia, Fortaleza, Salvador, Porto Alegre, Belo Horizonte, and Recife. Instead of investing in cost-effective busways, the government is catering subsidizing rail construction firms that will ultimately undermine the viability of more practical systems.

All of this is not to say that underground or grade-separated systems do not have their place. At higher urban population and traffic densities, grade separating different transport modes can make perfect sense from a financial, design, and safety standpoint. In some urban areas, the existing infrastructure and city layout may simply not allow above-ground options. Further, as Curitiba's population and transport use grows, the city is now considering separating grades at bottleneck points such as intersections. However, even in this instance, going underground is not necessarily the only option available. Sao Paulo demonstrates that busways and underground systems can even be complementary. In the dense and space-deprived central area of Sao Paulo, the city operates a well-run subway system that runs on three routes over a distance of 43 kms. As space then becomes more available outside the city core, the subway then connects with an array of busways that serve peripheral areas.

6. A new direction in technology transfer

The transfer of appropriate technology from the developed north to the developing south has long been a topic of international discussion. The present gulf in Internet access between the two is perhaps the most recent example. With much emphasis and investment by governmental and international donor agencies to facilitate north to south technology transfer, it is perhaps surprising to find a prolific example of technology transfer in the opposite direction, from the south to the north. The Latin American busway, though, has inspired the imaginations of transport planners world-wide and is quickly becoming an option of choice. From North America to Europe to Oceania, the busway will most likely be coming to a neighbourhood near you very soon.

The genealogy for many of these international efforts can be directly traced to Latin America and Curitiba. With the support of catalyst organizations such as the W. Alton Jones Foundation (W. Alton Jones Foundation, 2000), transport and civic professionals from around the world have visited Curitiba and noted its achievements. Following a visit by Los Angeles Mayor Richard Riordan in 1999, the California city where the automobile reigns supreme is now embarking upon its own busway programme. Officials from the US Federal Transit Administration (FTA) were so impressed with Curitiba's busways that they have launched a national programme to demonstrate the concept in ten cities nationwide (FTA, 2000). Canadian programmes such as Ottawa's Transitway and the Vancouver Rapid Bus are currently underway. In addition, five cities in Australia and New Zealand have formed a partnership to develop busways (Queensland Transport, 2000). The idea has taken hold in Europe as well with cities such as Eindhoven (Padilla, 1999) and London initiating efforts to reinvent their own bus transport systems.

The programme initiated by the US FTA is one of the most extensive to date. Ten US cities are directly participating as demonstration sites while another seven cities are

participating with busway programmes of their own. The programme is also seeking to improve the state-of-the-art in busway design features through an information sharing and research effort. The US FTA is supporting workshops across the US on busway design and has helped further new system attributes, such as Intelligent Transportation Systems (ITS).

Los Angeles is, to most people, synonymous with traffic congestion and poor air quality, and an almost palatable disdain for public transport forms. In 1995, the city began an attempt to overcome this image with the development of an underground metro system. Despite its mega-city status with a greater metropolitan population of over 12 million inhabitants, Los Angeles is a relatively low-density city sprawling across a wide basin. Thus, for many transport professionals, the attempt to develop a subway system in a city so widely dispersed was ill-advised; the city would be far more effectively and economically served by improving surface transport options. Instead, Los Angeles has accumulated a $7 billion debt on its new subway and other rail projects. Fare recovery is not nearly sufficient to cover the annual debt servicing costs of nearly $360 million per year (Economist, 2000). The Metropolitan Transit Authority has thus sought to reduce salaries of all transit staff (including bus operators) in order to partly offset the debt from the underground system. In September 2000, the entire metropolitan transit system was shut down by a paralyzing strike from outraged transit employees. In conclusion, Los Angeles in some respects was disadvantaged by its ability to raise large capital sums for its underground construction, as it permitted the city to follow a potentially inappropriate transport path.

One can only hypothesize where Los Angeles' transit system would be today if it had instead focused upon busways from the outset. Following Mayor Riordan's study tour to Curitiba, a video was produced on the applicability of busways to Los Angeles (Wellborne, 1999). The city is currently developing its *Metro Rapid* demonstration project featuring express buses. The first phase testing began in June 2000 and includes low-floor buses fueled by compressed natural gas (CNG) for additional environmental benefits. Like the Latin American systems, Los Angeles will utilize a

colour-coding scheme for both stations and buses in order to create a unified marketing identity.

Most of the busway systems planned in the US are currently in the developmental and pilot testing stage. Such works-in-progress include proposed busway systems in Los Angeles, Santa Clara, Hartford, Eugene, Cleveland, Boston, Louisville, and Oakland. A US system that is partially completed and has already proven its worth can be found in Honolulu. Despite the city's island paradise persona, Honolulu has long suffered air quality and traffic congestion problems. In its short period of operation, the Honolulu *CityExpress!* system has helped alleviate these problems and has won high public acceptance (see Figure 10). The system follows a 20-km costal path along the length of the city, and has now been expanded to include a new *CountryExpress!* extension

Fig. 10. Honolulu has utilized Latin American busway designs to develop its highly-popular CityExpress! system. Photo courtesy of the City and County of Honolulu, Department of Transportation Services.

which connects the city to other parts of the island. Another interesting programme underway is occurring in the US City of Charlotte, N.C. Charlotte in conjunction with the North Carolina state government has devised an innovative funding scheme to ensure that public transit programmes receive priority. A portion of the state sales tax is dedicated directly to public transit, and thus providing a consistent funding stream of approximately $50 million each year. The North Carolina Department of Transport has begun to fund 50% of the capital costs for proposed transit projects (FTA, 2000).

The developers of these planned and newly implemented busway systems are experimenting with several new design and technology features that can potentially further the appeal of busways. With the falling cost of information technology systems, sophisticated options such as Automatic Vehicle Location (AVL) are being tested and may prove to be economically viable. Satellite positioning of the buses permits a central control team to monitor the progress of each bus and react quickly to potential problems. The central control staff can use this type of technology to optimize spacing between buses and avoid bunching. Such information systems can also provide passengers with real-time arrival estimations through message boards at the stations. Prior knowledge of estimated arrival time can reduce waiting anxiety as well as permit the passenger to make more productive use of the time by undertaking another activity or performing an errand. Intelligent Transportation Systems (ITS) also provide further options such as signal prioritization in which traffic signals can detect an approaching bus and give priority to its passage.

Perhaps the various innovations from international programmes may even find their way back to improve the original Latin American busways. In this fast-paced environment of experimentation and creativity, it may be more appropriate to talk not of technology transfer but rather of a continual process of two-way technology exchange. In fact, the municipality of Porto Alegre, Brazil is now investigating the use of on-board position transponders for its fleet of 1,500 buses, and Sao Paulo is testing smart-card technology as part of a streamlined ticketing process (TCRP, 1999). However, part of the appeal and success of the Latin American busways has been their simplicity and

low cost. Whether the more technologically advanced innovations introduced by municipalities in North America, Europe and Oceania are indeed cost-effective remains to be seen. In any event, this type of experimentation holds much promise to boost the profile of busways.

7. Busway lessons

The advent of the Latin American busway holds many lessons for municipal officials everywhere, and the lessons are applicable not only to urban transport but rather to integrated urban development and our perceptions of how innovation occurs. Perhaps most importantly, the Latin American busways show that the availability of capital is secondary to political and technical will. Large budgets may in fact be counterproductive, as such spending availability stifles interest and creativity in seeking more optimal and cost-effective solutions. If, in the early 1970s, Curitiba had access to large endowments of funds, the city today might just be another case study of a loss-making metro system. The political will to create a sustainable urban vision is likely the real catalyst behind the inherent ingenuity of the busway.

The Latin American busways have also shown that innovation is not the sole domain of corporations and universities in the most developed nations. Southern nations have much to offer the world as incubators and creators of cost-effective designs. Municipalities in the north have much to gain from innovations launched in developing nations. Perhaps an earlier recognition of the advantages of busways could have saved Los Angeles from its current predicament of a heavily indebted subway and disgruntled workforce.

Busways, though, are certainly not the answer to all urban transport problems, and may not always be the best public transport solution to a given set of geographic, demographic and social conditions. An understanding of customer needs and preferences along with the city's physical space must be the starting point for any

transport planner. Further, busways are rarely successful as a stand-alone policy; their effectiveness is greatly enhanced by the presence of complementary transport options, such as pedestrian zones, bicycle routes, and integrated feeder services. And finally, despite the installation of busway systems and complementary options, car ownership levels are still likely to continue rising, along with resulting air contaminant levels and associated health and environmental costs. The goal of a clean and healthy urban living space for all is still far from being realized.

While the developers of the Latin American busways perhaps did not set out to create a new transport paradigm, the end result seems to be a revolutionary new way of looking at very basic transport and environmental issues. In a day and age when high-technology seems an increasingly integral step to advancement, it is perhaps surprising and refreshing to learn that simple, low-technology ideas are a cornerstone to resolving our most pressing social and environmental problems. In some ways, though, it is perhaps to be expected that the future will not be crafted exclusively by the microchip, but rather by human will and simple ingenuity.

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