How to Overcome the Ten Barriers to Effective BRT Planning

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Bus Rapid Transit (BRT) has much to offer but municipal leaders are often side tracked by spurious arguments that either denigrate BRT, or favor rail systems, or often both at the same time. In this article, Alan Hoffman, a stand out speaker at our Smart Urban Transport 03 Conference held last May in Sydney, Australia, examines the 10 most common barriers to planning and implementation of BRT systems.

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Bus Rapid Transit is not a transit mode per se; rather, it is a collection of techniques and treatments by which rubber-tired transit vehicles may be deployed in a variety of services. At one extreme, BRT can describe efforts meant to help improve the operating speed and reliability of "city buses"; at the other extreme, BRT can describe "rail emulation systems" in which train-like vehicles, operating in grade-separated infrastructure ("busways" or "transitways"), provide a "rapid transit" service much like any high-end rail system.

Regional corridor studies that attempt to compare BRT with Light Rail Transit (LRT) alternatives need to be careful in describing and costing the BRT alternatives. The goal in any such study should be to compare and contrast the best possible operating plan for each alternative within the constraints of public costs and timeframe; that is, for a given capital and operating budget (i.e., subsidy level), *what* can each mode best produce, in terms of ridership and community impacts, and by *when* can they impacts be produced?

This "apples to apples" approach contrasts with studies that have instead compared identical operating plans for BRT and LRT, ignoring the real differences in operating characteristics that in many cities leads to vastly different operating plans in practice. The chief argument of BRT proponents has never been that BRT vehicles are more attractive that LRT vehicles—they rarely are—but that BRT systems permit operating strategies that deliver more of what potential customers are really looking to "buy": shorter travel times, less waiting, fewer transfers, a higher degree of regional connectivity, and the potential of locating system access closer to where people are and to where they're going.

If a thoughtfully planned BRT system can in fact produce these desired outcomes, then BRT should hold forth a lot of promise for many metro areas. Too many corridor studies, however, commit ten errors of analysis that prevent BRT from being exploited effectively.

1. Overestimating the operating costs of BRT

What does it cost to operate a BRT vehicle, especially in a higher-speed operation such as a transitway or using freeway high-occupancy lanes? Transit agency cost allocation models across the USA, for example, consistently overestimate the costs of faster bus services because they don't distinguish between miles driven in stop-and-go traffic and miles driven in limited-stop, high-speed operations. The slower miles generate considerable wear-and-tear on vehicles, and they are notoriously fuel inefficient, especially with alternative fuel vehicles. Faster services, in contrast, generate far lower fuel and maintenance costs.

BRT studies that begin with transit agency cost data for express routes might therefore significantly overstate the real costs of operating BRT vehicles in a high-speed environment. This result not merely hurts the economic performance of BRT, but makes the cost of increasing frequencies or adding express services appear prohibitive when in fact they may be very cost-competitive and even cost-saving.

2. Double-counting operating costs

Studies that further fail to differentiate fixed costs from marginal (or variable) costs will double-count those costs. One recent study attempted to account for all possible costs of a busway operation, including station maintenance and security, but then divided these costs among a relatively low-frequency BRT plan, resulting in a high per-hour cost per vehicle. This cost figure was then used for any additional increases in service frequency, even though the fixed costs had already been paid for by the base service. This "double-counting" of operating costs made the costs of operating a high-frequency BRT system seem prohibitive, distorting the true picture of what BRT could have produced.

3. Underestimating the operating costs of light rail

Corridor studies that compare BRT with LRT alternatives often claim that the capacity of an LRT train may be increased simply by adding additional cars "at minimal cost." In fact, "adding another car" isn't free; the costs are generally much higher than assumed, due to a common misunderstanding about the performance of LRT systems—namely, that as labor costs are the largest source of costs in transit systems, and since light rail trains need only one driver, then adding a car must be virtually "free."

It is true that transit costs are labor-driven, but it turns out that drivers represent only a small fraction of the cost of operating a train—perhaps 10-15%. Most labor costs are actually generated by maintenance, which in the case of LRT is primarily mileage-driven. In fact, a review of the budget of one light rail operator in California suggests that the actual "marginal cost" of putting an additional light rail car into operation (less driver) is in the neighborhood of $50-60/hour—not much less than the marginal cost of operating an additional BRT vehicle, and certainly not "minimal" in the scheme of costs. Consequently, LRT plans that use *average* light rail costs but then rely on *additional* cars to create capacity will underestimate the costs of providing that capacity, perhaps by 25-30%.

4. Confusing the infrastructure with the "route"

With most light rail systems, the "line," the "route" and the "track" are all but synonymous; when a line is extended, it will likely serve a single route which will typically stop at all stations.

Mature BRT systems, such as those in Ottawa, Brisbane, and Bogota, don't operate that way. The underlying transitway infrastructure will typically support a variety of routes, ranging from all-stops to express. Bogota is an especially interesting example, because it operates transitways in urban corridors, which tend to require much tighter station spacing (averaging 500 meters) than non-urban corridors. Bogota operates several all-stops services, each of which deviates at some point from the core transitway to serve stations located on branching transitways; it then layers on a series of express (connecting a smaller set of stations) and super-express (bypassing large groups of stations to connect one end of the city with another) services, creating a rich mix of services with a single infrastructure.

Too many BRT studies still approach BRT as a light-rail substitute, in which the proposed busway supports only a single all-stops route, with station spacings typical of light rail lines (about 1.5 km. apart). Studies of potential ridership demand on single lines, however, will often show that the market exists for a range of services in many corridors, which if provided will likely generate additional ridership.

5. Forcing transfers to existing rail systems

Some regional transit studies have seen an opportunity to create BRT lines as "extensions" to existing rail systems (heavy and light rail); the idea is that riders would take BRT to the nearest rail station and then transfer.

While there is no denying the role that transferability has in an effective transit system, it is counterproductive to build a system around forced transfers to any mode. Most transit ridership studies in the have found a significant penalty associated with transfers; while it is possible to design transfers to minimize the negative attributes people assign to transferring, it will always be better to provide single-seat rides where it is feasible to do so.

Smart BRT plans look for opportunities to bring people directly to major employment sites, minimizing the need to transfer. Such plans are likely to generate higher ridership than forced-transfer plans, and the costs of doing so may be more competitive than most studies assume (see point #3 above).

6. Not matching capacity (frequencies) to demand

A more basic problem common to some BRT studies is their failure, early-on, to adjust frequencies to projected demand. BRT vehicles are lower-capacity vehicles than trains; their lower capacity is offset by lower *unit* operating costs, which permit increases in frequency (generating additional ridership) and the development of express lines (since the threshold at which express services become viable is so much lower with BRT). Still, even assuming a vehicle capacity of 90 people in a 60ft articulated vehicle, a BRT route will only be able provide capacity for 540 people/hour/direction on a ten-minute frequency service. If initial ridership projections show a peak location flow of 1200 persons/hour/direction, then the service plan needs to be adjusted in one of two ways: either by increased frequencies, or by the overlaying of express services among key ridership stations.

This process is necessarily iterative: as new frequencies and express routes are overlaid, most models will project additional increases in ridership that can be significant. However, the underlying economic performance of the system may be strengthened, not stretched, by such increases in service: express operations permit routes to be served by fewer vehicles in service at any one time, leading to more productive use of resources. Ottawa has learned this lesson with its Transitway: though Ottawa's bus fleet today is similar in size to its fleet of twenty years ago, ridership on that fleet is significantly higher; what has increased is the system's productivity.

7. Underestimating BRT infrastructure capacity

Some BRT studies have expressed concern that BRT is unable to provide the capacity of LRT systems. Such claims are based on a misunderstanding of BRT operating characteristics, as well as lack of knowledge about real-world experience with transitways.

According to the Transportation Research Board's Transit Capacity and Quality of Service Manual, three bus-based rapid transit facilities in North America all exceed the highest-ridership light rail lines in terms of peak flows. To use one particular example, Ottawa's Transitway moves over 10,000 passengers per hour per direction in at least two separate locations, equaling or exceeding flows on Calgary's light rail line and Boston's Green Line tunnel.

How is capacity gained on BRT systems? The answer lies in the use of express vehicles, but it is also found in the operating nature of BRT; headways of 15 or 20 seconds are feasible with BRT (Brisbane's Cultural Centre station is currently operating at 23 second peak headways without a passing facility), but light rail facilities, due to signaling and electrical systems, can rarely support headways better than 2-3 minutes.

The common reaction that such high frequencies on BRT would be prohibitively expensive to operate again doesn't take into account the actual marginal operating cost of higher-speed buses and the impact of express services in reducing the number of vehicles that need to be in operation at any one time. In fact, the use of express services can often reduce the number of BRT vehicles needed by 10-15% or even more under certain circumstances. The resultant service plan—shorter headways than comparable LRT service, with shorter in-vehicle time—is also likely to generate higher ridership.

8. Ignoring the revenue side of the equation

Operating costs are only one side of the financial picture; revenue is the other. BRT studies that begin by assuming a specific farebox recovery ratio do themselves a disservice; the revenue potential of carefully considered BRT systems can often produce better financial returns than expected. Vancouver, for example, has found its B-Line services much more financially productive than traditional bus services, due to the combination of lower operating costs per seat mile and the higher demand the service creates for that seat mile.

But ridership per se is only a part of the revenue picture. Indeed, there is a growing body of market research that suggests that design issues are important to driving customer "identification" with the service; the more potential customers view a service as designed for them, the more likely they are to use it, everything else being equal. This is precisely the argument made in favor of light rail systems: that they have an inherent "attractive power" that bus-based systems lack.

Early designs for Irisbus's Civis BRT vehicle proved especially popular in focus groups with choice riders, as the vehicle exhibited two characteristics very important for that market: aerodynamic design and transparency. (Image by Newlands & Co., www.nc3d.com)

This "attractive power" can be tapped by BRT systems through careful design of system components (vehicle interiors, vehicle exteriors, stations, and rights-of-way) and processes (fare payment, vehicle boarding, use and quality of information, route structure, etc.).

With regard to vehicle exteriors, focus group research suggests that much of the market responds to three dimensions of vehicle design: sleek and aerodynamic design, often epitomized by a "swooping" front end; transparency (from the outside looking in); or vehicles that are "small and cute." With regard to the swooping front ends, the point was raised at a recent US Federal Transit Administration-sponsored workshop that brought together transportation planners with BRT vehicle manufacturers. One of these companies noted that it had attempted to introduce a "swooping" front-end vehicle to the market several years ago, only to find that bus fleet managers, who specified the orders for transit agencies, rejected the vehicle as it would take an meter or so to park relative to other buses.

There is no denying the cost implications of additional garage space; but in the scheme of transit investments, such capital expenditures are often easier to come by than operating revenue (including fares). In this case, the rejection of a vehicle likely to be more attractive to potential riders was unfortunate, as the capital investment in a few extra parking spaces may well have generated a sustained increase in fare revenue and ridership.

9. Ignoring market research

The transit industry in many parts of the world has rarely incorporated market research as one of its core functions for the simple reason that it has been too preoccupied with serving the needs of captive riders in a cost-efficient manner. BRT systems, however, if conceived with the idea of attracting choice riders, must be planned with a careful eye to market perceptions and needs.

To illustrate, a number of regional decision-makers may not believe that BRT systems can attract as many riders as LRT systems, that buses are "bad" and trains are "good." There is a grain of truth to these feelings, and market research can go a long way to explaining the extent to which these beliefs are true and the extent to which they aren't—and what to do about it.

As an example, focus group research has consistently uncovered antipathy among choice riders toward what they call the "city bus," which is often characterized as "stuck in traffic," dirty, smelly (inside and out), slow, unreliable, and the like. On the other hand, people seem to respond far more positively to a bus when it's painted in a different livery, operates in a dedicated right-of-way, doesn't get stuck in traffic, and is boarded at stations, not side-of-the-road bus stops; one participant in one focus group went so far as to ask, "well, what's the difference between that and [light rail]?"—a rather startling statement, since the image in front of that person was very clearly that of a bus.

Market research also has a lot to say about waiting times (particularly for the work trip, frequency trumps mode), walk times (people are willing to walk longer distances to get to transit from their homes than they are to get from transit to their final destinations, and for the non-work trip, that final walk distance is critical), reliability, in-vehicle time, station design characteristics, transferring, and every other dimension of service. Smart BRT planning begins with an understanding of these "drivers of choice" so that the resulting plans actually create value for the intended end-user.

10. Thinking "thin" corridors

Most traditional transit infrastructure, such as heavy or light rail lines, create what may be called "thin" corridors—the walking influence of stations along such lines is generally limited to a rather small radius surrounding the station (perhaps 400-800 meters at the residential end and 250 meters at the work-trip end). The choice of alignment for rail, therefore, carries rather profound implications for which specific spots in a corridor will enjoy near access to transit, and what areas will depend on "city buses" or drive-up solutions to gain access.

BRT systems, by creating a core infrastructure that may be used by many distinct services, allow for the development of "thick" corridors, in which stations may be located off the alignment itself. It is entirely feasible in many instances to have stations 800 to 1500 meters, or farther, from the transitway itself, with one or more services leaving the transitway to reach the satellite station(s), particularly if a variety of bus priority measures are employed to ensure that the vehicle can break free of traffic. Such "branching" network structures are characteristic of transitway-based BRT systems; BRT vehicles can pick people up closer to their homes, use the transitway as an expressway to get to key destinations, and even exit the transitway to reach important destinations not actually on the alignment.

Corridor plans that look at BRT alternatives but that fail to develop full "thick" corridor options (as distinct from merely allowing "city buses" to use parts of the right-of-way) will lose out on the opportunity to create more "one-seat rides" among key origins and destinations, and hence will lose out on the opportunity to really push ridership above what "thin" corridor systems can achieve.

Lemons into lemonade: turning the barriers around

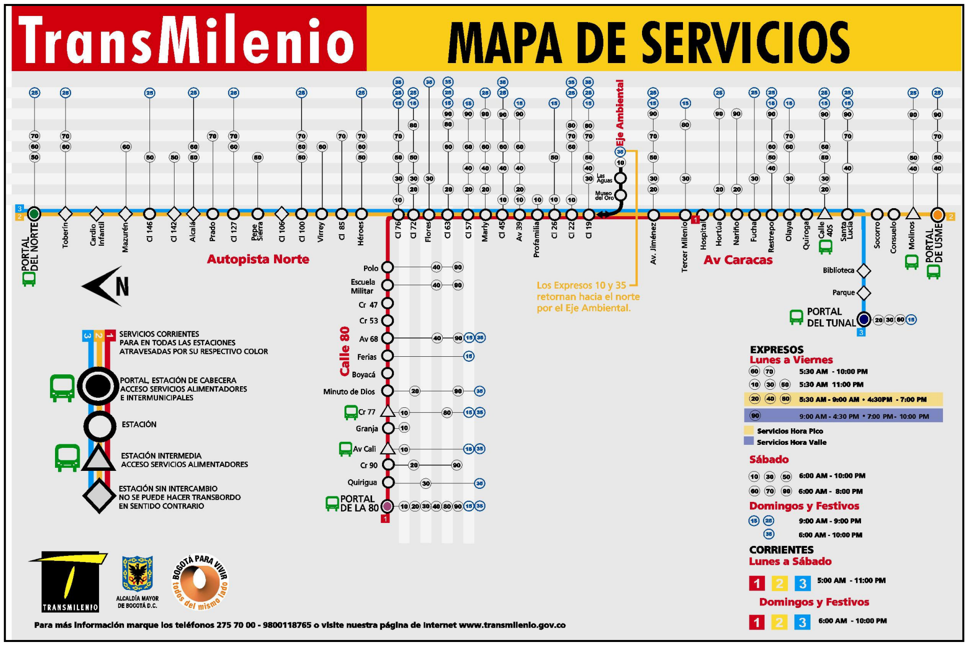
The lessons learned from the preceding ten barriers can be turned into a set of ten principles for effective BRT planning:

1. Be sure to adjust your operating cost models to reflect the lower per-mile cost of faster bus services.
2. Be sure to separate fixed busway operating costs from the marginal costs of adding additional vehicles to a service plan.
3. When costing LRT options, be sure that the projected operating costs reflect any increases in train size that the capacity calculations rely on.
4. When designing a busway-based BRT alternative, be sure to consider how the underlying infrastructure can be used to support a range of services.
5. Look for transfer opportunities within the larger transit system, but don't cut lines or infrastructure short just because there's a train station nearby.
6. Use demand (ridership) projections strategically to develop a service plan that matches supply to capacity in the most efficient manner.
7. Don't underestimate the capacity of BRT systems just because of the relatively low capacity of the individual BRT vehicle. Often enough, the cost of providing high capacity is still competitive with other modal options, especially if it pulls in additional riders (hence revenues).
8. Pay attention to the revenue side of the equation, particularly when calculating projected subsidy levels and when looking for opportunities where small capital investments can produce ongoing revenue streams.
9. Employ market research—not merely "community involvement"—to help design your BRT product and services.
10. Think "thick" corridors when planning BRT alternatives.

Conclusion

BRT systems have great potential for creating cost-effective and high-ridership transit services, but only if they are planned correctly. Given the relative lack of experience with such systems in the US, too many corridor studies don't effectively exploit the very characteristics of BRT that have allowed it to make such considerable contributions to cities as diverse as Brisbane, Bogota, Ottawa, Quito, and Curitiba.

Those who are interested in studying BRT alternatives will need to get smarter on the real cost structure of such services as well as the kinds of networks and overlaid services that BRT systems make feasible and desirable. If they do so, they will lead to better plans, better strategies, and in the end, better returns on our investment in transit systems.



Bogota's new TransMilenio BRT service features an innovative mix of local and express (skip-stop) services, providing most people with an express, one-seat ride among principal origins and destinations.

