Comparison of Bus Rapid Transit & Light Rail Transit characteristics 1931

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With the recent success of various Bus Rapid Transit BRT investments around the World, many transport planners have been given the task of comparing BRT to Light Rail Transit or LRT.

On one end of the spectrum, some planners have become BRT advocates, saying that it is always superior to LRT. BRT uses vehicles that have rubber tyres and can be steered, thus providing implementation, operating and passenger service flexibility unachievable with LRT.

At the other end of the spectrum, there are planners that denigrate BRT, saying that it is always a second choice for precisely the same reasons; it is so flexible that it is difficult to assure the permanently high quality of service that both potential passengers and real estate developers demand.

The fact is that no single type of rapid transit investment will be ideal in all situations. Each potential rapid transit application should be planned on a case-by-case basis, with an unbiased, objective and comprehensive analysis of all reasonable and feasible options, both rail-bound and flexible rubber-tired, for the given corridor or sub-area situation.

The criteria used to compare rapid transit investments should reflect the investment goals and objectives held by decision makers and the public.

Criteria will, of course, include capital, operating and maintenance costs, direct impacts and transportation system performance; however, sustainability, the potential to afford environmental improvements, land use and economic development are also increasingly important.

In many US urban corridors, both LRT and BRT investment are worthy of study. BRT and LRT performance characteristics such as service levels, speed, reliability and costs vary greatly as a function of the specific application as will ridership.

One can not make generalisations about which mode would either perform better or cost less in a specific corridor or sub-area environment based on national or even individual modal system averages from the same region. Using regional average bus cost and performance data to evaluate a potential rapid transit application in a specific corridor or sub-area can lead to incorrect conclusions.

This is true for LRT systems where national cost and performance averages are dominated by core systems in older, denser more traditional cities that are fundamentally different from what is being implemented elsewhere.

This is especially true for BRT, given that most operating and maintenance cost and performance data available for the bus mode generally describes entire systems with broad geographic scope.

These systems may encompass 100's of route miles, thousands of stops and span an entire region.

US operating data for the bus mode also typically reflects a steep ratio between the number of buses operated during peak and base periods.

Because of the premium pay dictated by union work rules for split shifts, the unit hourly costs of BRT services operated all day can be expected to be lower than regional averages covering all types of services.

Capital, operating and maintenance costs should be compared for the entire transit system, including both the individual rapid transit lines in the respective corridor and sub-area, and all feeder facilities and services. The same holds true for speeds and travel times.

During planning, speeds and/or travel times should be compared on a trip origin to trip destination basis, not average line-haul revenue speeds from the point where individual passengers are on actually on a rapid transit vehicle with no regard as to how they actually got there.

The information below is intended to provide some basic parameters that either might used in "sketch" planning or are shown for illustrative purposes.

The numbers come from a variety of sources, including the US Transportation Research Board's Transit Capacity and Quality of Service Manual, the Federal Transit Administration's National Transit Data Base, issues of the American Transit Association's Passenger Transport News, and the September 2001 Report of the *General Accounting Office, Mass Transit: Bus Rapid Transit Shows Promise.*

General BRT Characteristics Compared To LRT

Running Way	BRT	LRT
Operating environments	Dedicated to transit, priority, mixed traffic: at-grade, subway, elevated	Same
Minimum required right-of-way (ROW) width	11 feet (1 lane reversible) - 40 feet (2 lanes + shoulders) 24 feet (Guided vehicles)	12 feet (one track) 24 feet (2 tracks)
Vehicles	**BRT**	**LRT**
Length	40 feet (single unit standard) — 82 feet (double articulated)	48 feet (PCC) — 120 feet (double articulated)
Capacity (3sqft/standee)	65 — 140, depending on internal layout and number of doors	80 — 200, depending on internal layout and number of doors
Trainable?	No (but trolleybus +trailer trains are used in a number of European cities)	Yes; limited by block lengths for street running
Propulsion	Diesel, gas, electric, hybrid	Electric, diesel
Boarding	Street, low, high platform	Same
Doors	Multiple, one (or both sides)	Same
Top speed	55	Same
Max acceleration	1.2 mph/Sec — 3+mph/Sec	1.35 mph/Sec — 3+mph/Sec
Unit cost, new	$325,000 (standard 40 feet clean diesel) - $1.2m (60 feet diesel-electric dual mode, low-floor Artic.)	$1.5m (single unit, 60 feet) — $3m (double articulated, low floor)
Stations	**BRT**	**LRT**
Platform dimensions	Min 16 feet width (centre platform station) Length function of demand and available space	Same
Passenger amenities	Passenger information, shops, services, etc.	same
Unit Cost	$50,000 +	same
Minimum headway	60- 90 seconds (local, depends on station dwell time)	same
Average revenue speed (miles per hour — mph)	6 mph (CBD circulator) - 55 mph (express on dedicated ROW); Depends on vehicle, stop spacing, dwell times and operating environment	6 mph (CBD circulator) - 55 mph (express on dedicated ROW); Depends on vehicle, stop spacing, dwell times and operating environment
Theoretical maximum load point directional capacity: Depends on vehicle design, dispatching, ROW access control, station spacing and design, fare collection approach and other factors	4,000 passengers per hour (40 feet buses, mixed traffic) 20,000 + trips per hour (bus platoons, two dedicated lanes, skip-stop, station by-pass lanes	5,000 passengers per hour (48 feet single unit street cars, 2 tracks) 20,000 + trips per hour (dedicated ROW, 2 tracks)
Demand Experience	**BRT**	**LRT**
Actual maximum load point volumes (TRB *Transit Capacity and Quality of Service* manual, 1993-96 data); APTAs *Passenger Transport News*	Actual bus passenger volumes for selected bus facilities; maximum passengers/hour, maximum load point, peak direction	Actual LRT volumes; maximum passengers/ hour, maximum load point, peak direction
Ottawa West Transitway	11,000/ hour	
Pittsburgh East Busway	5,400/ hour	
North Virginia Shirley Hwy HOV	5,000/ hour	
Denver I-25 Transitway	2,775/ hour	
Boston Green Line subway		9,600/ hour
Toronto (Queen @ Broadway)		4,300/ hour
Philadelphia (subway)		4,130/ hour
Portland Max Eastside		2,000/ hour

Capital Costs	BRT	LRT
Total Capital Cost/Mile ($US) (recent experience, FTAs *FY99 New Starts Report*)	**$1 - 3** million/mile (**Minimum**; BRT on dedicated, existing street and/or highway lanes, limited to costs of stations and systems, new livery for existing buses (e.g., LA Wilshire-Whittier, Ventura Blvd. Metro Rapid Bus) **3.5** million/mile (Las Vegas Blvd. North, including Civis vehicles) **$8** million/mile (Miami Dade South Busway extension, abandoned railroad ROW) **$10** million/mile (New Britain-Hartford Busway, mix of railroad ROW, highway and street running) **$22** million/mile * (Cleveland Euclid Corridor Project, mix of exclusive lanes on arterial and mixed traffic, articulated diesel - electric trolley bus) **$22** million/mile (Pittsburgh, Swissvale extension of MLK Busway) **$60** million/mile (Pittsburgh Airport Busway, mixed railroad ROW, extensive elevated ramps at western terminus)	**$9** million/mile * (**Minimum**; mixed single/double track Diesel MU LRT on railroad ROW, e.g., Raleigh-Durham) **$21** million/mile * (Salt Lake City, mix of on-street and railroad ROW) **$28** million/mile * (Medical Center extension, Memphis Streetcar, on street running) **$15** million/mile * (Sacramento Mather Field Road Extension, railroad Row) **$44** million/mile * (San Jose Tasman Corridor west extension) **$50** million/mile * (average Federal New Start LRT capital cost, reported in FTAs *FY99 New Starts Report*) **$100** million/mile * (Northern NJ Hudson-Bergen, mix of on-street and railroad ROW) * Includes LRT vehicles
Operating/Maintenance Costs	**BRT**	**LRT**
(costs/revenue vehicle hour)	**Average, system-wide Bus Operating and Maintenance Costs**	**Total LRT System Operating and Maintenance Costs**
San Jose VTA	$106.99/vehicle hour	$199.27/ vehicle hour
Sacramento RTD	$ 78.88/ vehicle hour	$145.73/ vehicle hour
Portland Tri Met	$ 70.79/ vehicle hour	$186.03/ vehicle hour
St. Louis Bi State	$ 80.98/ vehicle hour	$187.41/ vehicle hour
- San Diego Trolley		$ 95.67/ vehicle hour
- San Diego Transit	$ 57.75/ vehicle hour	
- North San Diego County TDB	$ 58.32/ vehicle hour	
- Denver RTD		$128.99/ vehicle hour
- Denver RTD	$ 86.70/ vehicle hour	
Denver RTD Laidlaw Contract Bus	$53.37/ vehicle hour	
Dallas DART	$ 85.20/ vehicle hour	$164.31/ vehicle hour
Cleveland RTA	$ 82.87/ vehicle hour	$184.86/ vehicle hour
Pittsburgh PAT	$ 90.51/ vehicle hour	$229.83/ vehicle hour

Notes:

1) Bus Operating and Maintenance (O/M) costs shown are regional bus system averages and do not include BRT-related station and running way related O/M costs;

2) Unit Costs per Vehicle Hour are shown only for illustrative purposes. They should not be used for predictive purposes in specific situations. Other O/M cost measures such as Costs per Revenue Vehicle Mile, Costs per Passenger Mile and Costs per Passenger Trip are too closely related to the specific application environment within a given metropolitan area to be of any, even illustrative value.

3) Approximate conversions 1 mile = 1.6 kilometres, 10 feet = 3 metres. All $ are US $.

Source: *National Transit Data Base, FY 98*

Annual Administrative, Operating and Maintenance Employee Hours per Vehicle in Daily Peak Service

System	Bus	LRT
San Jose VTA	7,759	14,281
Sacramento RTD	5,992	8,844
Portland Tri Met	6,709	22,983
St. Louis Bi State	5,844	12,946
- San Diego Trolley		11,194
- San Diego Transit	7,922	
- San Diego County	7,490	
- Denver RTD	7,421	12,097
- Denver RTD Laidlaw Contract Bus	6,829	
Dallas DART	8,816	17,336
Cleveland RTA	7,610	14,881
Pittsburgh PAT	6,929	21,711

Notes:

1. Bus employee loading are regional bus system averages and do not include BRT station and running way related labour requirements.
2. Loadings per Peak Vehicle are shown for shown only for illustrative purposes only. They should not be used for prediction in specific situations.

Source: *National Transit Data Base, FY 98*