Comparative examination of New Start light rail transit, light railway, and bus rapid transit services opened from 2000

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Modes Examined



Electric light rail transit (LRT)



Diesel-multiple-unit (DMU) light railway



Bus Rapid Transit (BRT)

BRT Definition Issues

- This study defined BRT as bus services operating on exclusive or reserved alignments with in-line stations i.e., in some form of "guideway".
- Nominal "BRT" systems <u>operating in mixed</u> traffic were excluded.





- For any BRT project, <u>only segment in</u> <u>exclusive or reserved alignment (i.e., in</u> <u>"guideway" or paveway) was included.</u>
- Segments in mixed traffic (i.e., buses departing from operation in guideway) were considered ordinary limited-stop street bus operation.





Research Issues Investigated

- Major differences in capital cost per mile (km) among LRT, DMU light railway, and BRT?
- Major differences in how closely final capital costs match projected/budgeted costs?
- Major differences in how well ridership goals are achieved?

Research Data Criteria

- Projects studied: Selection of "New Starts" LRT, light railway, and BRT projects opened since 2000.
- "New Start" projects mostly new systems, or major extensions to existing new systems, receiving New Starts funding or oversight from the FTA.
- Other totally new projects examined where data were readily accessible.
- Data must be reliable and compatible.

- Study results limited because of constraints on readily available data.
- Projects excluded where data insufficient or not readily available.
- DMU light railways of New Jersey Transit's <u>RiverLine</u> (Camden-Trenton) and Capital <u>Metro's MetroRail</u> (Austin, Texas metro area) <u>excluded</u> because of serious cost and operations data availability problems.
- <u>Circulator-type streetcar lines excluded</u>, but line-haul lines included.

O&M Data Problems

- Operating and maintenance (O&M) cost data (particularly per passenger-mile) either not readily available, or not available in a consistent, standardized form to facilitate reliable, fair comparisons.
- BRT operations data routinely <u>blended in</u> and reported with systemwide bus data.
- For <u>extensions</u> to existing LRT systems, crucial evaluatory data are almost <u>never</u> <u>disaggregated from systemwide LRT data</u>.

Except for just a handful of projects, adequate data was hard to find...

And it seemed our study might be doomed...



But suddenly, as if handed down from above...



... Help was found in the form of two excellent FTA-funded studies:

- Federal Transit Administration (FTA), Office of Planning and Environment with support from SG Associates, Inc., Predicted and Actual Impacts of New Starts Projects Capital Cost, Operating Cost and Ridership Data (September 2003)
- FTA, Office of Planning and Environment with support from Vanasse Hangen Brustlin, Inc., *The Predicted And Actual Impacts Of New Starts Projects* 2007 Capital Cost And Ridership (April 2008)

These supplemented other sources of raw data for analysis in the study.

Evaluatory Methodology

Final Capital Cost per Mile

- Projects categorized on basis of type and magnitude of construction.
- Minimal installation at-grade projects with less than 5% of route length involving heavy civil works (e.g., grade separations, elevated, tunnels)
- <u>Substantial</u> installation projects with <u>5%</u> or more of route length involving heavy civil works.
- Costs uniformly escalated to 2012 dollars.

Final-to-Projected Capital Cost Ratio (CCR)

- Evaluates how well final investment cost adhered to original cost estimate.
- Final cost divided by last projected cost (adjusted for any known expansions of project scope), and rounded to two decimals.

• 1 — project completed exactly within budget (good).

• <1 — project completed under budget (very good).

• >1 — budget overrun (poor).

Ridership Achievement Index (RAI)

- Developed to assess degree that projects with widely <u>differing levels of investment</u>, service, ridership, etc. meet original average daily (weekday) ridership targets, while also accounting for targets set for <u>differing lengths of time</u>.
- Used <u>latest available projection</u> (e.g., DEIS, FEIS, FFGA).
- Focuses on <u>rate of ridership growth</u>, beginning with first full calendar year after opening, and <u>compares with the rate</u> needed to achieve the initial target.

$$\frac{15,000 \text{ riders}}{10 \text{ years}} = 1,500 \text{ riders/year}$$

$$RAI = \frac{2,000 \text{ riders/year}}{1,500 \text{ riders/year}} = 1.3$$

• 1 — project meeting ridership target (good).

• >1 — project exceeding target (very good).

• <1 — project not meeting target (poor).</p>

Cases Studied

LRT Projects Studied (20)

Substantial Installation

- Denver Southwest LRT Line (2000)
- Portland MAX Red Line (2001)
- St. Louis Metrolink St. Clair Extension (2001)
- Dallas Red Line extension,
 Park Lane to Plano (2002)
- Los Angeles Gold Line to Pasadena (2003)
- Portland MAX Yellow Line (2004)
- Minneapolis Hiawatha LRT (2004)
- San Diego Mission Valley East extension (2005)

- Hudson-Bergen County, New Jersey — HBLRT (2000-2006)
- Denver Southeast LRT Line (2006)
- Charlotte Lynx Green Line (2007)
- Seattle Link LRT south segment (2009)
- Portland MAX Green Line to Clackamas (2009)
- Los Angeles East Gold Line (2009)
- Norfolk The Tide (2011)

Minimal Installation

- Portland Portland Streetcar (2001)
- Sacramento South LRT Line (2003)
- Houston MetroRail (2004)
- Memphis Madison Avenue/Medical Center streetcar extension (2004)
- Phoenix Metro (2008)

DMU Light Railway Project Studied

Substantial Installation

• Oceanside-Escondido — Sprinter (2008)



BRT Projects Studied (5)

Substantial Installation Minimal Installation

- Pittsburgh West Busway (2000)
- Boston Silver Line Phase II/
 Piers Transitway/Waterfront tunnel (2003)
- Los Angeles Orange Line Busway (2005)
- Eugene, Oregon Emerald Express (2007)
- Cleveland HealthLine/Euclid Avenue (2008)

Case Examples

Final Capital Cost per Mile LRT Substantial Installation

Lowest

St. Louis — Metrolink St. Clair Extension (2001)

- 17.4 miles (28.1 km)
- \$339.2 million, <u>CCR 1.05</u>
- <u>\$28.5 million/mile</u> (\$17.6 million/km)
- Ridership: 15,976 (2002), RAI 7.1



Highest

Seattle — Link LRT south segment (2009)

- 15.6 miles (25.2 km)
- \$2.57 billion, <u>CCR 1.03</u>
- <u>\$182.6 million/mile</u> (\$113.2 million/km)
- Ridership: 26,200 (2012) RAI 2.3



Final Capital Cost per Mile LRT Minimal Installation

Lowest

Portland — Portland Streetcar (2001)

- 2.4 miles (3.9 km)
- \$56.9 million, <u>CCR 1.20</u>
- <u>\$34.6 million/mile</u> (\$21.5 million/km)
- Ridership: 4,820 (2003), RAI 2.9



Highest

Phoenix — Metro (2008)

- 19.6 miles (31.6 km)
- \$1,400.0, <u>CCR 0.99</u>
- \$82.0 million/mile (\$50.8 million/km)
- Ridership: 44,000 (2012), RAI 2.6



Final Capital Cost per Mile BRT Substantial Installation

Lowest

Pittsburgh — West Busway (2000)

- 5.6-miles (9.0 km)
- \$419.2 million, <u>CCR 1.28</u>
- <u>\$113.1 million/mile</u> (\$70.1 million/km)
- Ridership: 9,000 (2002), RAI 1.0



Highest

Boston — Silver Line Phase II/ Piers Transitway/Waterfront tunnel (2003)

- 1.0 mile (1.6 km)
- \$790.3 million, <u>CCR 1.31</u>
- \$790.3 million/mile (\$490.0 million/km)
- Ridership: 12,500 (2007), RAI 1.0



Final Capital Cost per Mile BRT Minimal Installation

Lowest

Eugene, Oregon — Emerald Express (2007)

- BRT 2.5 miles (4.0 km) out of total route of 3.9 miles (6.3 km)
- \$24.6 million, <u>CCR 1.89</u>
- \$11.7 million/mile (\$7.2 million/km)
- Ridership: 9,600 (2012), CCR (NA)



Highest

Cleveland — HealthLine/Euclid Avenue (2008)

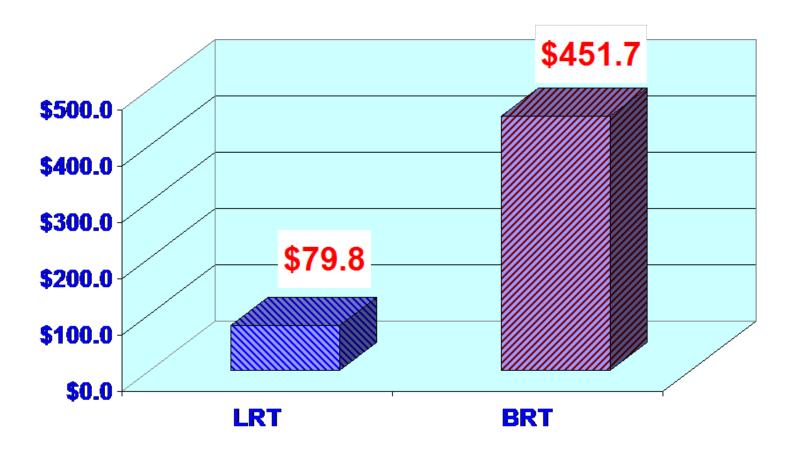
- BRT 4.4 miles (7.1 km) out of total route of 6.7 miles (10.8 km)
- \$197.2 million, <u>CCR 1.17</u>
- <u>\$51.4 million/mile</u> (\$31.9 million/km)
- Ridership: 15,000 (2012), RAI 1.6



Summary Analysesand Conclusions

Capital Cost per Mile

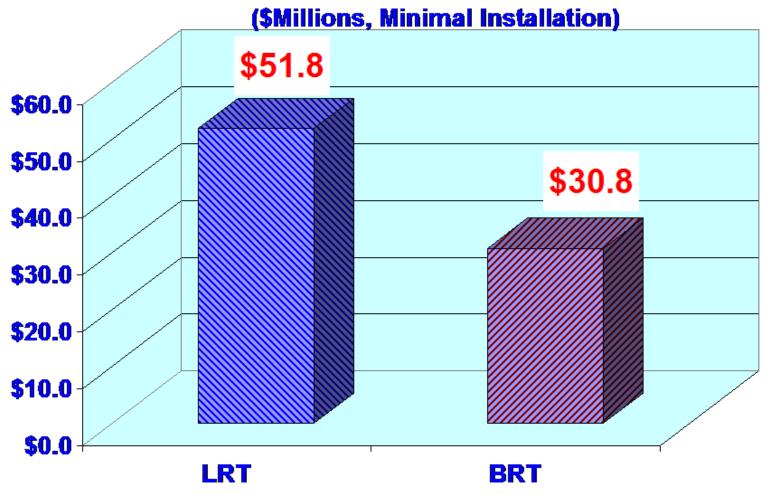
(\$Millions, Substantial Installation)



DMU light railway (Sprinter) — \$25.2 mn/mile

- BRT projects studied <u>did not have any</u>
 <u>particular advantage</u> when very heavy
 installation (tunnels, elevated structure,
 etc.) was involved <u>BRT average capital</u>
 cost per mile (km) much higher than LRT.
- DMU light railway project much <u>lower in</u> capital cost per mile (km) than average BRT or LRT.

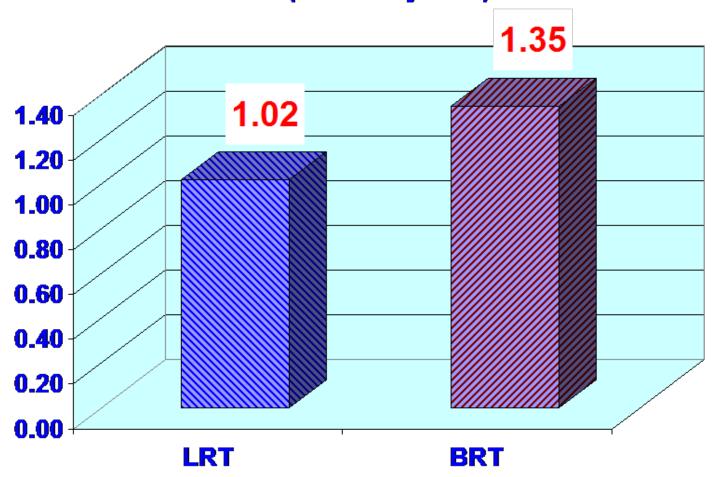
Capital Cost per Mile



Average capital cost of "Minimal Installation"
 BRT projects studied were 40% lower than LRT.

Capital Cost Ratio

(Final:Projected)

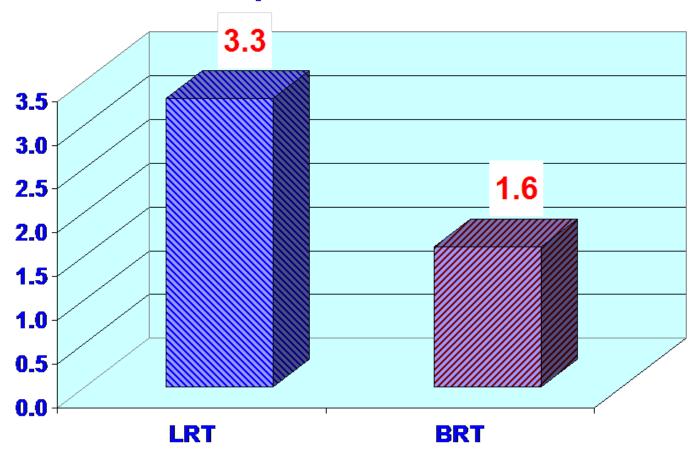


DMU light railway (Sprinter) — CCR = 1.38

 Average capital cost overruns were 24% higher for BRT projects studied than for LRT.

 DMU light railway project studied had higher overrun than LRT or BRT.

Ridership Achievement Index



• DMU light railway (Sprinter) — RAI = 0.8



• LRT projects studied met ridership targets much better (2X) than BRT projects.

 DMU light railway project studied did not meet ridership target.

Additional Conclusions

- Merely comparing gross capital cost and ridership is insufficient.
- Comparative evaluation needs to <u>account</u> for different economic lives of systems and rolling stock.
- Evaluation difficult because of <u>lack of any</u> consistent, standardized data reporting system.
- Some projects <u>neither clearly set nor state</u> <u>critical goals</u> (e.g., ridership targets), nor report key data even after project is operational.

- BRT project <u>ridership targets</u> (if any) are <u>rarely publicly revealed</u>.
- BRT project ridership and O&M costs are typically <u>blended with systemwide bus</u> <u>data</u>.
- Streetcar project ridership targets often obscured or ignored.
- LRT <u>extension</u> project data (e.g., ridership and O&M costs) <u>almost never</u> <u>disaggregated</u> from systemwide LRT data.

Recommendations

- FTA should mandate <u>consistent</u>, <u>standard</u> <u>evaluatory data criteria</u>.
- Useful elements: ridership, passengermileage, O&M cost (gross and per passenger-mile), and total cost (both annualized capital and O&M, gross and per passenger-mile).
- Critical evaluatory data <u>should be made</u> readily accessible for public scrutiny.
- All projects should <u>establish ridership</u> targets and report progress in meeting those targets for extended period after project completed.

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