BART Impact Update

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ABSTRACT

When representatives of the multi-year, multi-million dollar San Francisco Bay Area Rapid Transit (BART) Impact Program presented their conclusions to the TRB Annual Meeting in January 1979, BART had not yet achieved a reliable level of operation. The findings had been based on data gathered in the early period of full-system operations (1974-1977). The thrust of the findings was that hoped-for impacts of BART on travel had not materialized because of the constraints on BART operation and the limited market BART was focused on. These and even earlier findings by a university research group have been widely quoted in the literature and used in textbooks. This paper contains documentation as to what has happened with BART use and travel in the primary BART service corridor since 1978, and an illustration showing that many of the earlier constraints on BART patronage and, thus, its impact, have been relieved. BART's service reliability has improved dramatically, attracting many new patrons, and population and employment in BART's market area have grown. As a result, BART carries a large share of trips in its intended market--long-distance commute trips to the urban core.

It is difficult in some circles even to bring up the subject of the impact of the San Francisco Bay Area Rapid Transit (BART) system (see Figure 1) without immediately polarizing those individuals present. The debates began from the earliest findings of the BART Impact Program, the elaborate federally funded study that was conducted from 1972 to 1978. In 1976, a university research group published its interpretation of the early results, and those largely negative findings have found a permanent place in the transportation planning literature (1-4) and in textbooks (5,6). Transit professionals with an interest in rail transit development responded in their own professional journals (7,8).

It was not until late 1978 that the formal BART Impact Program concluded with a full-day presentation of findings to the TRB Annual Meeting in January 1979. The production of final reports continued into 1979, and the fifteen project reports and final Program summary report were not broadly distributed until late 1979 (9). By that time, the debate had cooled, but its impact could be seen in each of the Program reports. The "Sponsor's Note" ("Sponsor" meaning the U.S. Department of Transportation), which appears at the front of each report carefully lays out the circumstances surrounding the study, its limits, and the factors affecting the findings. The 2-page caveat incorporates many of the key points of the debate--special institutional setting in the Bay Area, system not running at full service levels, short period of operating experience, etc.

One methodological recommendation of the BART Impact Program was for continuation of a low-level, long-term monitoring program. There was little interest in pursuing the suggestion, except for continuing the semi-annual counts of vehicle and person traffic across the San Francisco-Oakland Bay Bridge corridor, the primary BART service route. For lack of a comprehensive approach to updating all the major findings on the impacts of BART, the following pages contain information concerning only the trends in BART travel and the patterns in the Bay Bridge corridor. Even this modest update may help inject some new information into the on-going debates concerning rail transit (10).

BART DESCRIPTION

In one sense, not much has changed since the BART Impact Program concluded. There are still 34 BART stations, 71 mi of track, 450 cars, and 23 parking lots with approximately 22,000 spaces. The fare is still distance-based and collected automatically, although fare increases have boosted the range from $0.25-$1.45 reported in 1978 to $0.60-$2.15 in 1984. The BART patron is still more highly educated and more affluent than the general public, reflecting still the high degree of BART use for suburbanites' work trips (see Table 1). The average trip length is still approximately 13 mi, although the true trip-length distribution is approximately evenly bi-modal--a short-distance peak at 6-8 mi and a trans-bay peak at about 20 mi. The 13-mi "average" is an artifact of that distribution and, in fact, there are few 13-mi trips on the system.

In another sense, though, BART is a very different system from that studied from 1972 to 1978. Minimum peak-period headways are now under 4 min instead of 6 min. Revenue car availability at the start of morning peak service has climbed from 60 percent in fiscal year (FY) 1975-1976 to 90 percent in FY 1983-1984. Unscheduled train removals have been cut from 17.3 per day in FY 1975-1976 to 2.2 in FY 1983-1984. Consequently, there has been nearly a 33 percent increase in the number of car-miles of service provided. The result has been an increase over that period of more than 60 percent in passenger trips and over 75 percent in passenger-miles. This has allowed the farebox recovery ratio to climb from 39 percent to 49 percent while cost per passenger mile has remained flat at $0.15-$0.16 despite inflation (see Table 2). Though BART's operating cost per passenger-mile is similar to that of other U.S. rail systems, its cost per passenger is relatively high. This is due in part to its long average trip length (see Table 3).

BART PATRONAGE TRENDS

BART patronage has been sensitive to external events, such as transit labor disputes (its own and others)

FIGURE 1 BART system map.

and sudden changes in gasoline price and availability. Still, there has been a steady growth in BART's primary transbay market. Figures 2 and 3 show the trend in BART's average daily patronage each month from September 1974 (the month the Transbay Tube was opened) to July 1985. Trips in the East Bay (Alameda and Contra Costa Counties) have grown from about 40,000 to 50,000 trips per day, while West Bay trips (San Francisco and Daly City) have grown from 30,000 to 50,000. A jump in West Bay trips occurred in April 1983 with the introduction of a joint BART/San Francisco Municipal Railway monthly pass. Transbay trips have grown from 50,000 to over 100,000. Transbay trips now comprise 50 percent of all BART trips. The proportion of BART trips in the morning and evening peak periods, however, has changed little, from 45-50 percent in the early years to 50-55 percent now. Figure 2 shows each of the three major market components separately, with the West Bay and East Bay components now almost equal. Figure 3 shows the contribution of each market to BART's cumulative patronage. (Note that BART average weekday patronage data are taken from BART's monthly patronage reports. The following events affected patronage:

November 1975-fare increase
April-May 1976-San Francisco MUNI labor dispute
September 1977-BART labor dispute
November 1977-January 1978-AC Transit labor dispute
January-April 1979-Transbay Tube closed by fire
May 1979-"gasoline crisis"
August-November 1979-BART labor dispute
July 1980-fare increase

TABLE 1 BART Passenger Characteristics

Characteristics	1976	1978	1980	1980 Census	1982
College graduates (%)	40.8	44.0	45.4	24.9	46.4
White (%)	76.5	74.6	67.2	62.9	68.2
Annual incomes over $20,000 (%)	35.7	47.1	53.7	47.1	66.0
Age 35 or older (%)	38.8	43.6	44.3	44.2	44.4
Work trips (%)	65.5	74.2	74.4		77.4

Note: The BART passenger data are from BART's series of Passenger Profile Surveys, and the census data are averaged for the three BART counties.

TABLE 2 BART Financial and Operating Characteristics, 1976-1984

Characteristics	Fiscal Year 1976	1977	1978	1979	1980	1981	1982	1983	1984
Net operating expenses (million $)	55.126	66.814	78.204	86.548	88.457	103.256	117.820	125.281	134.046
Fare revenues (million $)	21.714	24.692	28.219	28.727	25.942	46.207	52.677	60.965	65.492
Farebox ratio (%)	39.4	37.0	36.2	33.2	34.4	45.3	45.2	49.1	48.9
Average fare ($)	0.708	0.738	0.723	0.685	0.733	0.964	0.988	1.110	1.10
Cost per passenger mile ($)	0.133	0.146	0.155	0.166	0.155	0.155	0.154	0.162	0.166
Car miles	22,446,355	22,862,970	24,046,898	26,806,000	20,046,000	27,707,000	28,505,000	29,177,000	29,852,000
Unscheduled train removals per day	17.3	11.7	10.1	9.0	8.1	7.8	5.3	4.5	2.2
Revenue car availability (%)	60	76	87	82	76	83	86	89	90
Total passenger trips	32,897,431	34,599,088	38,665,206	41,191,566	34,482,335	46,879,319	53,290,643	53,699,387	58,277,463
Passenger miles	414,507,631	444,401,162	492,901,000	500,221,000	443,085,000	626,662,000	717,998,000	725,077,000	761,799,000
Average trip length (mi)	12.6	12.8	12.7	12.1	12.8	13.4	13.5	13.5	13.1

Source: Annual Reports of the San Francisco BART District.

TABLE 3 U.S. Rail System Characteristics *(11)*

Operator	Trip Length (mi)	Expense per Trip ($)	Expense per Passenger-Mile ($)
BART	12.5	2.168	0.173
Rapid rail systems			
New York City (CTA)	4.2	1.009	0.242
Chicago (CTA)	7.3	1.274	0.175
Philadelphia (SEPTA)	5.5	0.938	0.171
Boston (MBTA)	3.0	1.012	0.333
Washington, D.C. (WMATA)	4.3	1.282	0.296
Cleveland (GCRTA)	7.8	1.339	0.171
Atlanta (MARTA)	3.3	0.514	0.156
Lindenwold (PATCO)	8.7	1.518	0.174
Group average	5.5	1.111	0.215
Commuter rail systems			
Chicago (RTA)	19.9	3.330	0.167
Philadelphia	11.6	17.626	1.517
Boston	18.7	4.304	0.230
Detroit (RTA)	18.2	10.495	0.577
New Jersey (NJT)	23.3	4.858	0.165
Pittsburgh (PAT)	14.9	5.572	0.374
Group average	17.8	7.531	0.505

Other than the preceding incidents, missing data account for some of the zero points in Figures 2 and 3.)

The noted improvement in the quality and quantity of BART's service is one factor promoting patronage, but there are others. Figure 4 shows data on the growth in population in the three BART counties since 1974, which was taken from the California Department of Finance. In the period studied by the Impact Program, San Francisco's population was declining while the East Bay's population was relatively flat. Since then, all three counties have grown, with suburban Contra Costa County (a large transbay commute market) growing the fastest.

Figure 5 shows data on employment growth in the larger metropolitan area, where most of the workplaces are within the three BART counties. (The data were taken from the California Employment Development Department.) Substantial growth has occurred (nearly 40 percent) since 1975 in the service and finance categories, both of which are well-represented in the central urban areas served by BART.

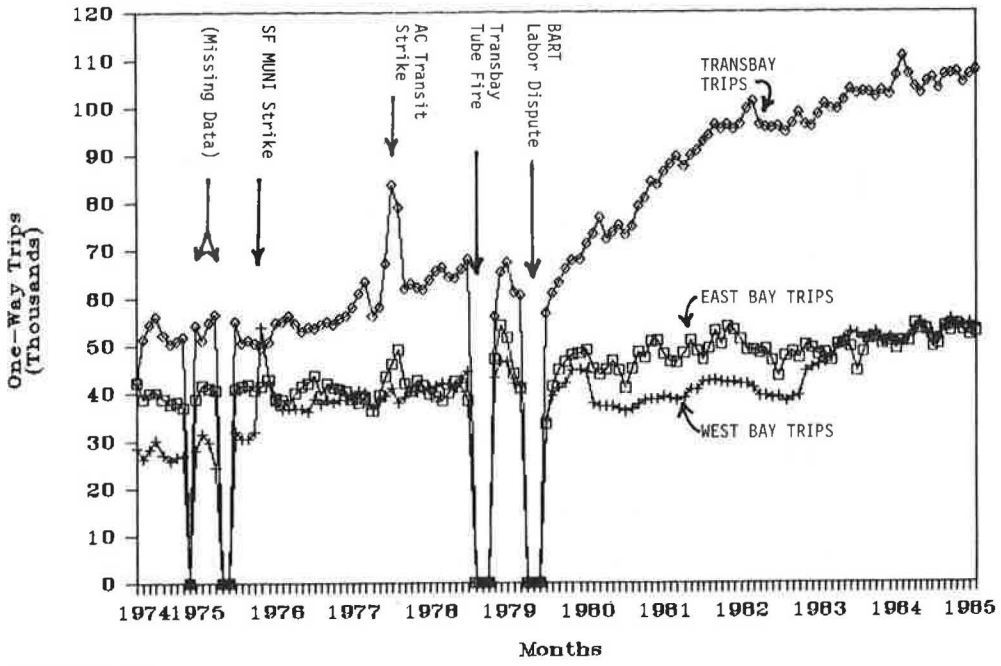

FIGURE 2 BART patronage by market (markets shown separately).

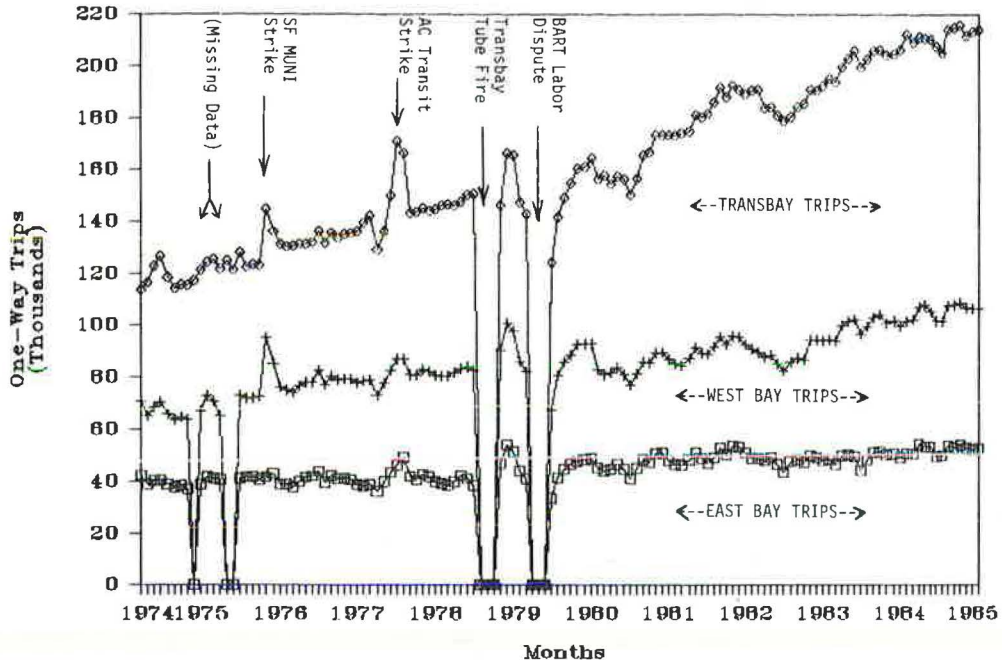

FIGURE 3 BART patronage by market (markets shown cumulatively).

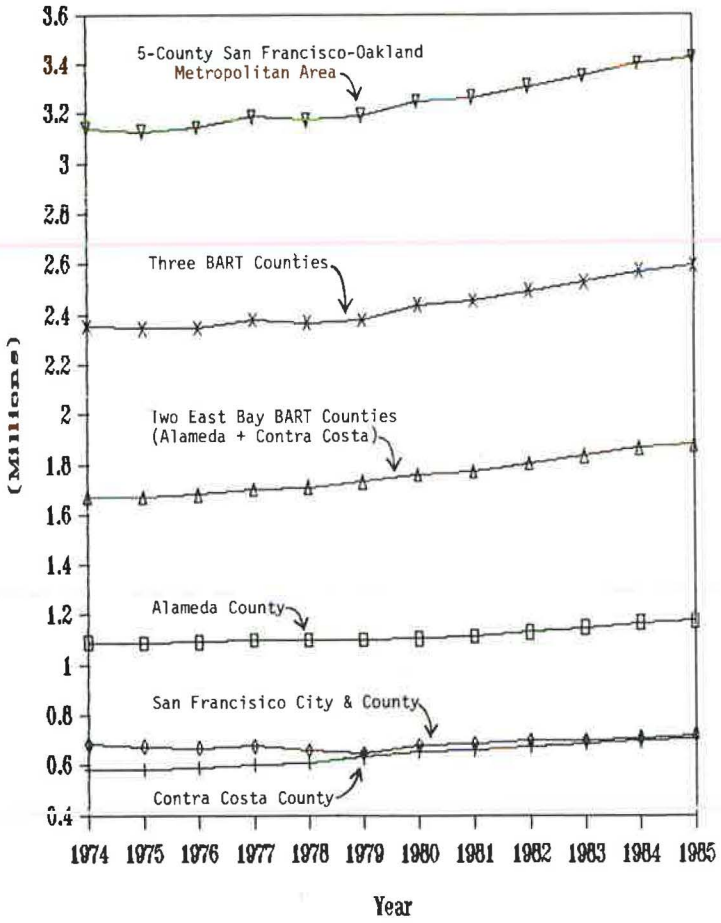

FIGURE 4 BART area and regional population—1974-1985.

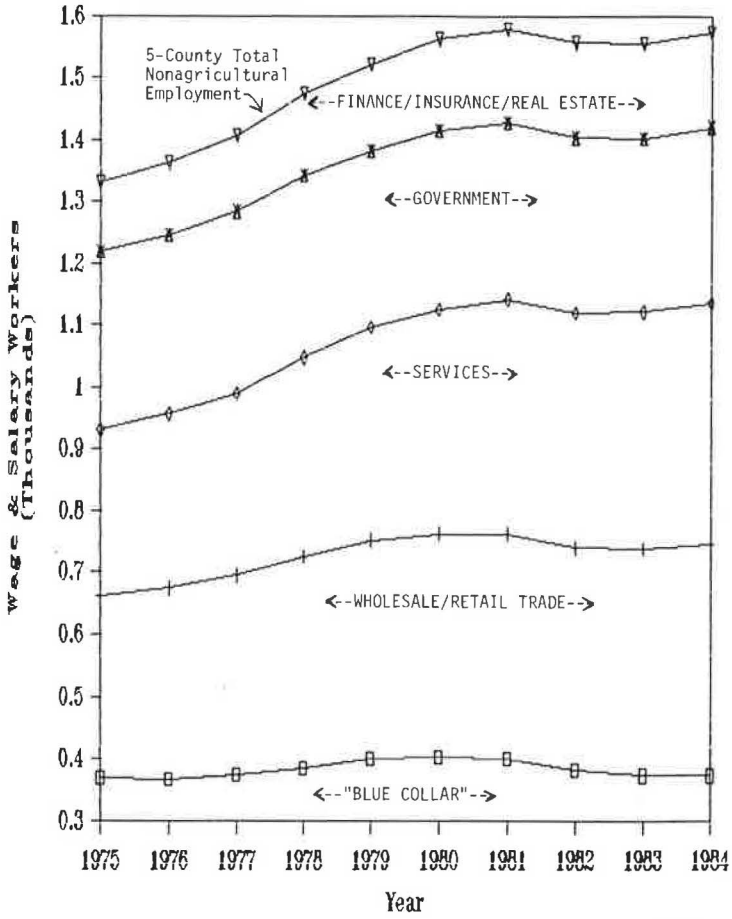

FIGURE 5 San Francisco-Oakland metropolitan area employment—1975-1984.

Finally, Figure 6 shows the change in unleaded, self-service, gasoline prices in Northern California for each December since 1975. The dramatic increase of 1979-1981 occurred after the conclusion of the BART Impact reports.

The final report of the BART Impact Program's study of transportation impact noted potential sources of future patronage growth and cited limits to that growth. The principal limits were seen as BART's unreliability, slow growth of jobs and population in its service area, and continuing dependence on the automobile (12). Since 1978, these constraints have apparently been reduced--reliability is greatly improved, population and jobs have increased, and the price of gasoline has somewhat reduced the attractiveness of automobile travel.

BART has ambitious plans for expanding service through the remainder of the decade. These plans include: (a) increasing the number of cars in the fleet to 489 (an increase of 150 cars), (b) increasing the maximum number of trains in service from 43 to 74, and (c) reducing the minimum scheduled headway from 3 min and 45 sec to 2 min and 15 sec. Two major capital improvements are underway to help achieve these goals. Currently, BART is completing an additional subway track through downtown Oakland to increase operational flexibility and reliability. Funding has just begun for a turnback facility and storage yard beyond the Daly City Station, the western terminus of the line through San Francisco. BART projects that if these and other improvements are in place by 1989, patronage will increase to 285,000 trips per weekday--an increase of 30 percent (13).

BAY BRIDGE TRAFFIC

What of BART's effects on highway travel? The BART Impact Program found that BART's contribution to the relief of congestion in the Bay Bridge corridor, the principal link between the East Bay and San Francisco, was short-lived. The attractiveness of downtown San Francisco as an employment center has increased, not diminished, since 1978. The demand for travel in that corridor in the morning peak period has increased 40-50 percent since the opening of BART's Transbay Tube in September 1974. Figure 7 shows the long-term trend in westbound, a.m. peak-period person trips by mode since 1970. Some 75,000 persons cross the Bay by automobile, bus, or BART each morning, compared to 50,000-55,000 in 1974. The steady increase in person-trips was interrupted only briefly in 1979 with the large increase in gasoline prices. As Figure 8 shows, the increase in westbound transbay travel demand is true for the entire 24-hr day, not just for the peak period. From 1975 to 1985, vehicle trips increased 22 percent (from 94,000 to 115,000), while transit person trips increased 43 percent (from 45,000 to 66,000) and total person trips increased 34 percent (from 174,000 to 233,000).

The demand may have increased dramatically, but the bridge is still only five lanes wide in each direction. The peak demand has been spread in three of the only four ways possible: (a) motorists are filling in the shoulders of the peak, (b) automobile occupancies have climbed and (c) BART is carrying more of the load. The fourth alternative is the use of buses; however, there has been a decline in both

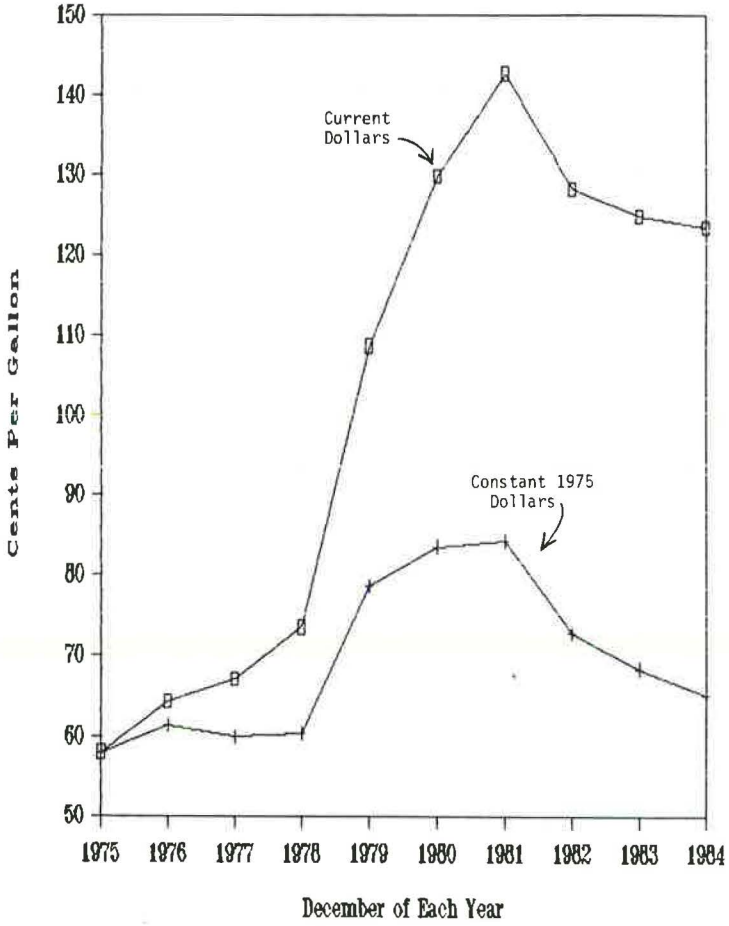

FIGURE 6 Gasoline prices.

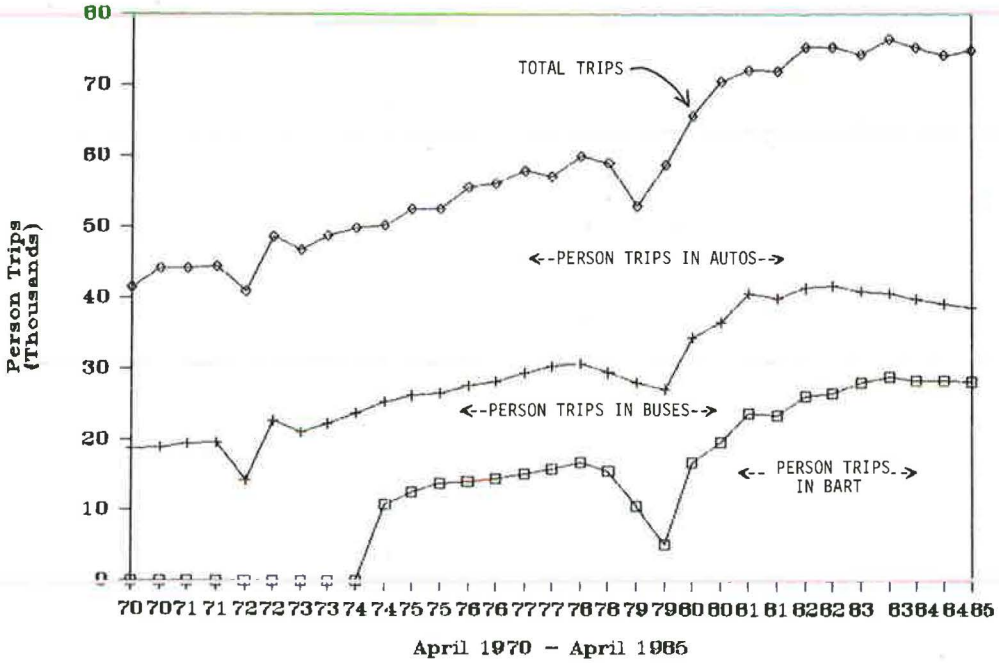

FIGURE 7 Bay Bridge a.m. peak traffic, 1970-1985 (note that there were two observations per year—in April and October—and the a.m. peak is from 6:30-9:00).

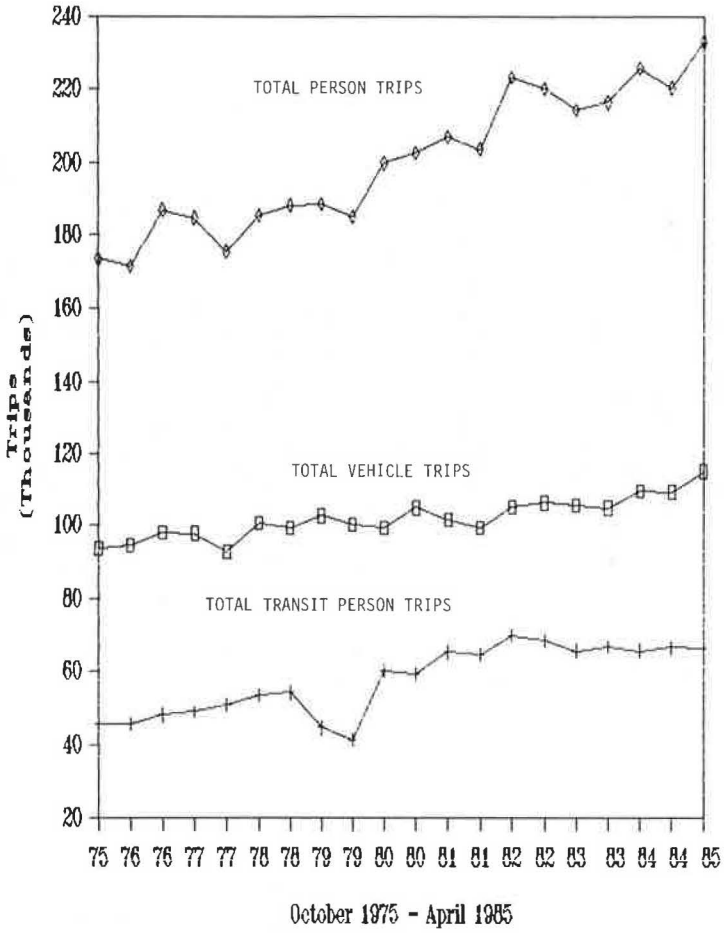

FIGURE 8 Bay Bridge 24-hr traffic, 1975-1985 (note that there were two observations per year—in April and October).

magnitude and proportion of bus riders carried in the transbay corridor. Figure 9 shows the change in the shape of the peak for westbound, a.m. peak-period vehicle traffic since 1974. Each of the twice-yearly observations--October and April--show the vehicle traffic by 30-min increments from 6:30 to 9:00 a.m. Over time, the earliest 30-min period has grown to equal the second 30 min period and all traffic from 6:30 to 8:00 has gradually crept up to the theoretical limit of the bridge's capacity. Bridge planners typically use a figure of 1,800 vehicles per lane per hour, which translates into 4,500 vehicles per 30-min period. The October 1980 data point in the middle of the peak in Figure 9 is therefore suspect because it exceeds that capacity by several hundred vehicles.

Figure 10 shows that automobile occupancy has increased considerably in the westbound, a.m. peak-period from the 1974 average of 1.4 passengers to the 1985 average of 1.8 passengers. Incentives for car- and vanpooling may have had an effect, including reserved toll-free high-occupancy vehicle (HOV) lanes through the Bay Bridge toll plaza during the peak. The usual toll is $0.75 ($0.60 with a commute ticket book) in the westbound direction, but a more significant incentive may be the reserved lanes, which have been estimated to save as much as 10 to 15 min in travel time during the most congested periods. (Note that for Figures 9 and 10, there were 2 observations made per year--in April and October--and the a.m. peak period is from 6:30 to 9:00. Note also that the 5 vertical bars for each year represent 30-min a.m. peak period increments as follows: 6:30-6:59, 7:00-7:29, 7:30-7:59, 8:00-8:29, and 8:30-8:59.)

Figures 11 and 12 show the share of westbound, a.m. peak-period person trips now being carried by each mode in the a.m. peak. Figure 11 shows the absolute number and Figure 12 shows the percentage share. With the filling in of the peak and the increases in automobile occupancy, the share of person trips in transit has grown moderately from 50 percent in 1974 to 52 percent in 1985. BART's share has grown from about 20-25 percent to 35-40 percent because of diversion from buses and growth in its Contra Costa County market area.

It should be noted that Figures 7-12 are based on a series of counts conducted by the University of California, Berkeley, Institute for Transportation Studies of the California Department of Transportation for the Metropolitan Transportation Commission. Methods changed somewhat over time. The dates selected for counts are "typical" mid-week days in October and April. The traffic counts are done for only one or two days and the transit data are collected from the appropriate agencies for those days. Some changes in bridge operations during the period also affected capacity, including a toll increase in July 1977, changes in the placement and hours of carpool lanes and the operation of metering lights.

Is the Bay Bridge peak congestion lessened by BART? No, but the answer depends on perspective. Without BART, it seems unlikely that the bridge could support the current level of peak trip making in the corridor, although certainly some increased portion could be carried by additional buses. For

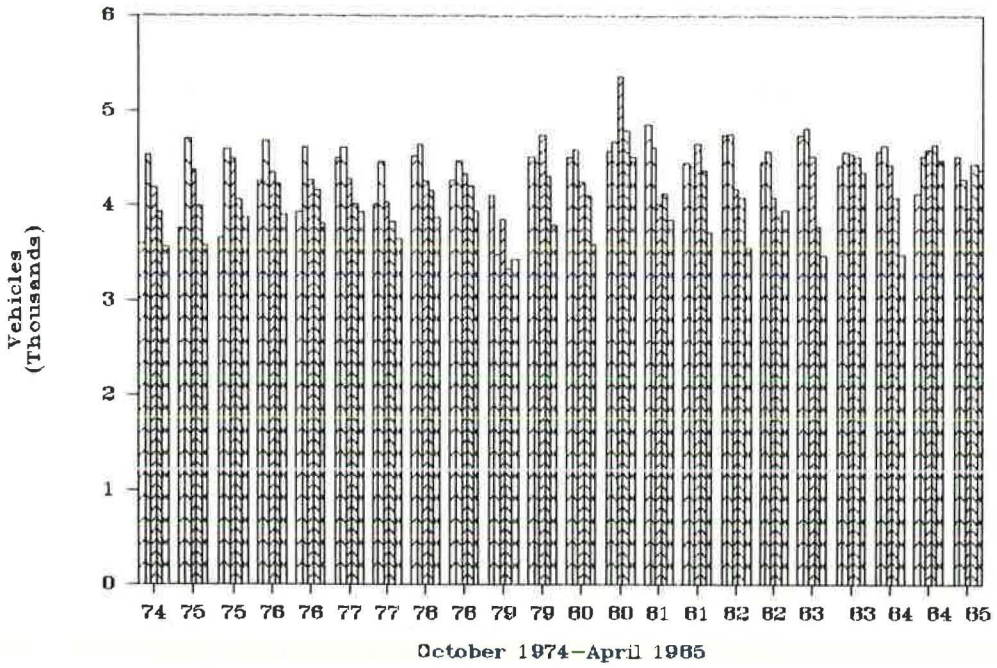

FIGURE 9 Bay Bridge a.m. peak vehicle traffic, 1974-1984.

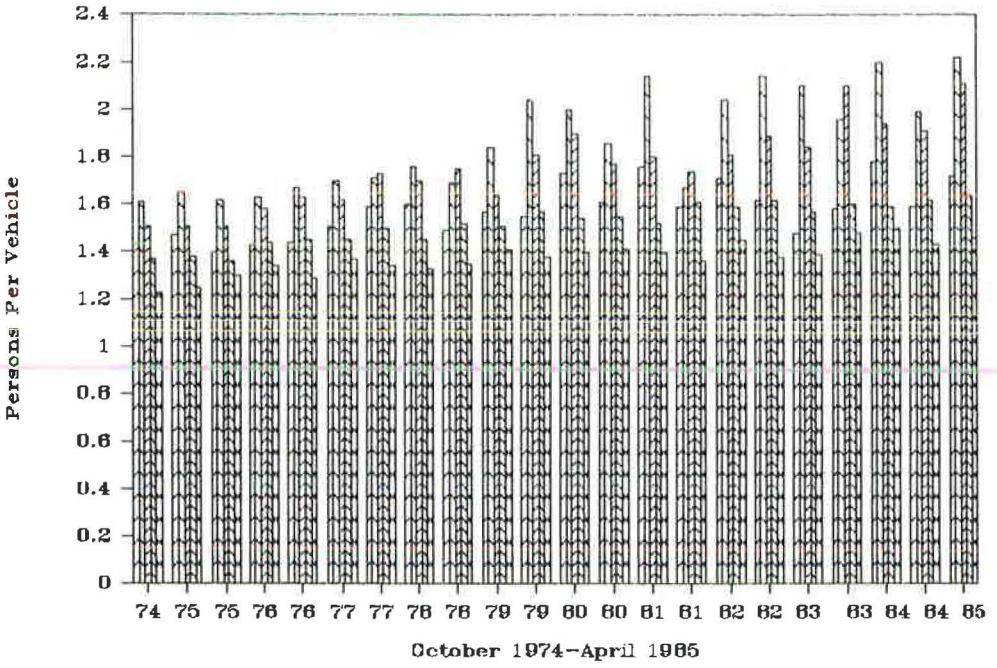

FIGURE 10 Bay Bridge a.m. peak vehicle occupancy, 1974-1984.

example, to carry the 28,400 April 1984 BART peak-period patrons in buses would require over 730 additional bus trips at typical peak loads, compared with only 336 actual bus trips, and 610 bus trips in 1974, before transbay BART service began. The 730+ vehicles, on top of the actual peak vehicle load, would have pushed three of the 30-min periods over the theoretical bridge capacity and a fourth period within 5 percent of that limit. Whether the level of demand itself would be lower without BART is a matter of conjecture beyond the scope of this summary.

Those who hoped for traffic congestion relief from BART may have made a heroic assumption: that travel demand would remain constant in the busiest corridor in the region that serves one of the most desirable central business districts in the nation, in an area with a vigorous economic, population, and white-collar employment growth. The good news is that BART has helped satisfy that demand for travel; the bad news is that the demand is excessive, causing continued congestion. Hindsight suggests this should have been no surprise. Similarly, hoped-for benefits in the areas related to traffic congestion relief, such as air pollution reduction, cannot be detected because BART travel is still a small fraction of total regional trip-making.

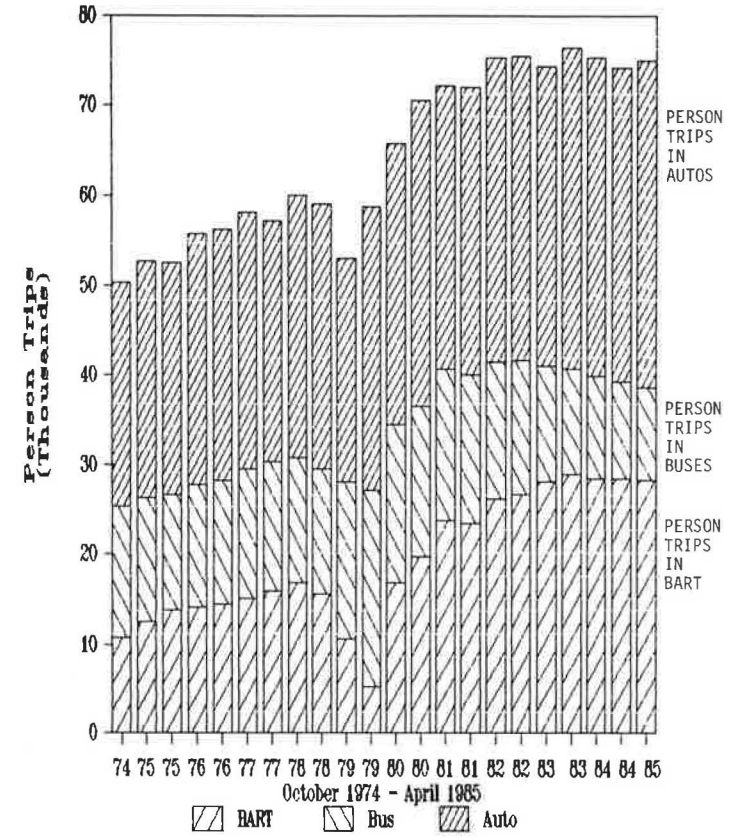

FIGURE 11 Bay Bridge a.m. peak person trips by mode, 1974-1984.

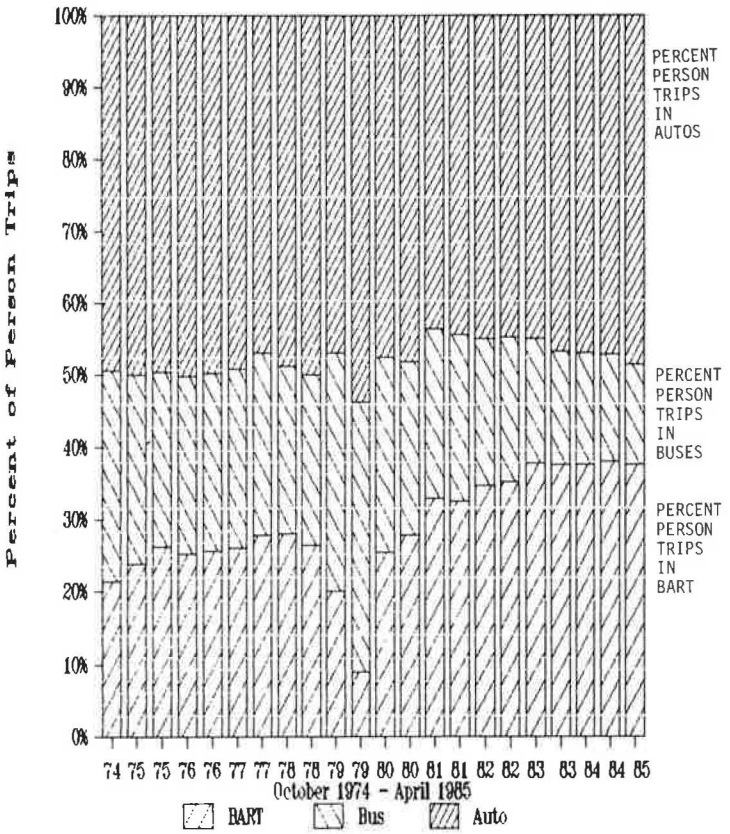

FIGURE 12 Bay Bridge a.m. peak person trips modal shares, 1974-1984.

CONCLUSION

This brief review was not intended to be a comprehensive examination of all aspects of BART's impacts, nor even a detailed statistical analysis of transportation and travel impacts. Reliance on descriptive material and graphs is intended only to provide some basic information to update the largely outdated material from the early BART Impact Program findings and other sources from the early 1970s from which many individuals still seem to be quoting. The material briefly presented here demonstrates that BART's performance and patronage have improved dramatically since the early reports were published. While hardly the panacea for the Bay Area's urban transportation problems, BART has increased its effectiveness in serving its primary intended market--the long-distance commute trips to the urban core. The debate on new rail transit systems and extensions will continue, and there will always be a demand for information on BART as a referent for that debate. This paper can contribute only modestly to that demand.

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