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BART IMPACT STUDIES

Public Transportation: Wish Fulfillment
And Reality in the San Francisco Bay Area

by

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The San Francisco Bay Area has long had an ambivalent relationship with the automobile. In 1949 just as the postwar love affair with the automobile was starting there was movement in the State legislature to create a Rapid Transit Commission for the Bay Area. In 1957, at the height of that love affair, the San Francisco Bay Area Rapid Transit (BART) District was started. In 1959, when city fathers elsewhere were scrambling for their share of the generous Interstate Highway System the Board of Supervisors of San Francisco looked at the ninety per cent gift horse and objected to the location and design of planned freeways in San Francisco. In doing so they expressed several profound wishes. The Composite Report (CR) of 1962 to the BART District represented the direct fulfillment of some of those wishes. The voters of the three counties, Alameda, Contra Costa and San Francisco, approved the bond issue which the report advocated and thus affirmed that these were their wishes as well. Between 1962 and the present the dream has been acted out.

The reality differs in many ways from the dream.

This was a social dream: the fulfillment of several actors' wishes. The engineers had a vision of the specifications of the system, its costs, time to completion and patronage. Later the U.S. Department of Housing and Urban Development (HUD) supported a plan which would co-ordinate several transit modes: the publicly-owned Alameda-Contra Costa Transit District (AC) in those two counties, the San Francisco Municipal Railway (Muni), Greyhound and Peerless Stage buses. Simpson and Curtin, (S&C) transportation engineers, delivered a plan

to optimize joint revenues and patron service. The BART District suggested an allocation of costs among property taxpayers, the State Division of Bay Toll Crossings, the federal government and patrons. Cognizant federal agencies hoped that BART would be an important experiment in public acceptance of high-quality rapid transit.

San Franciscans sought to differentiate their city from its sibling Los Angeles. They have long disdained its pattern of development, dedicating large fractions of the available land to driving, storing and maintaining the automobile. J. K. Galbraith used Los Angeles as an example of a type of squandering land use in The Affluent Society. Los Angelesation has become a pejorative term (See Sesser). The voters of 1962 opted for nucleated development. Secondly, in the early sixties San Francisco sought to become the Manhattan of the West: its financial capital. Its peninsular status, closely approximating Manhattan Island, the Federal Reserve Bank, Pacific Coast Stock Exchange and headquarters of many large banks and corporations encouraged San Franciscans in this regard. Finally, the Board of Supervisors of 1959 objected to the "visual pollution" of the Embarcadero Freeway which interfered with their view of the Ferry Building and the Bay. They dreamed of an out-of-sight railway which would obviate aerial structures.

It is unfortunate that solutions to the problem other than fixed-rail rapid transit were not considered. Engineers' answers to social problems often involve fixed structures like dams, highways or rail rapid transit lines. The range of alternatives considered by economists is typically no less narrow. William Vickrey, George Hilton, Alan Walters and others have offered solutions utilizing congestion pricing to ameliorate peak-load problems. Both groups are simply practicing their trades when they respond as above. It was left to an

interdisciplinary team of economists and an engineer: Meyer, Kain and Wohl to include buses with exclusive lanes in a comprehensive cost comparison of urban transit modes. This was a new concept in the early 'sixties when BART was actively being planned.¹ If we are concerned with rush-hour traffic, why have large investments in facilities devoted seven days per week, 24 hours per day to solving a problem which exists only about 20 hours of a 168-hour week?

I. Specifications, Costs, Time to Completion and Patronage

The BART system in 1971 is surprisingly faithful to the promise of 1962 by comparison with other public works projects whose specifications typically change over the planning and construction period. There are still 75 miles of track. One station has been added, Embarcadero, the first after the transbay tube in San Francisco. Several miles of track were placed below grade in Berkeley. The mileage of above-grade track was reduced and the below-grade and at-grade track was increased so that the system is roughly evenly divided among the three grade types. The main deterioration over the decade has been in the planned amount of rolling stock to be procured. Plans in 1962 called for 450 cars but a substantial increase in their per-unit cost results in 250 being procured now. This will probably mean a deterioration in headways: they are now two minutes instead of ninety seconds at peak hours (Stokes).

Average speed will be 45 m.p.h. instead of 50 as promised and the capacity of the two-track line will be 28,800 seated passengers per hour instead of 30,000 (Stokes). There is reason to doubt BART's ability to keep to that headway for very long. It would take 400 cars to serve 28,800 seated passengers per hour in 72-seat cars and I doubt cars can make a round trip and return for service in one hour.

Patronage estimates ranged from the sanguine expectation of 77.5 million annual trips in 1975 of the CR to 56.6 to 57.6 million (depending on fares charged) in the 1967 Simpson and Curtin report. BARTD's May 1971 estimate of annual ridership is 58.9.

Several estimates of average weekday adult volumes (in thousands) in 1975 have been made. Henry Quinby, working for the engineer joint venture estimated 258 in the early 'sixties. In 1967 S&C estimated 253 with a minimum fare and about 196 with other fare plans. Wilbur Smith and Associates estimated 219 and the BARTD revised estimate of 1971 is 191. BART's current estimate is 25 per cent lower than the patronage anticipated in 1962.

Construction costs and pre-operating expense for the basic system were about \$1304 million instead of the \$923 million anticipated: a 41 per cent cost overrun. Total capital costs also increased about 40 per cent but only 250 transit cars are being procured instead of 450 (See Table 1). By comparison with other public projects this cost overrun is not very bad. Summers, in a study of weapon systems costs found actual cost 3.25 times estimated cost, on the average. This was in the military field where time to completion and performance characteristics are so much more important than costs and where new technology is involved. Altouney found the ratio of actual to estimated costs to be 2.63 among Bureau of Reclamation projects. Hufschmidt and Gerin quote the ratio as 2.24 for Corps of Engineers projects prior to 1951. This ratio improved to 1.36 by 1964. They note improvement in agency performance over the years, especially after Congressional scrutiny in the 1950's, such that the Corps had an average overrun of only 11 per cent on projects since 1954. The Tennessee Valley Authority actually experienced an average underrun on project costs amounting to 5.3 per cent. Many of their projects are financed through revenue bonds instead of Congressional appropriations. Agencies which have to return to a legislature or the bond market for funds for several projects tend to be better at cost

estimating both because of a learning-by-doing phenomenon and a need to establish credibility with the legislature. "Ad hoc" projects, not executed by an agency which will continue to pursue other projects tend to have poorer cost estimating. A study by J. F. Tucker shows an average cost overrun on "ad hoc" projects of 73 per cent. That sample may be biased, however. For some purposes it is desirable to adjust initial cost estimates for changes in project scope and inflation before a comparison with actual costs is made. BART did not change much in scope over its nine years of construction. Its cost estimates included inflation at 20 per cent over a six-year construction period and contingencies at ten per cent.

Several factors worked against BART's cost performance. A taxpayers' suit at the outset delayed the project six months. Anticipated inflation was about three per cent per year, but the actual Viet Nam War inflation caused the Engineering News Record Construction Cost Index in San Francisco to grow at a compound rate of 6.5 per cent in the period 1960-1971.²

The BART District promised four fifths of its system would be operating by January 1969 and the whole system by July 1971. Current plans expect a start of very limited service in early 1972 and service on the complete system, except streetcar facilities in San Francisco, by March 1973. So the system is three years late in coming.

Table 1
 Comparison of Capital Costs, Bay Area Rapid Transit

	<u>Composite Report</u> ¹	<u>Comparative Data Report</u> ²
	\$ thousands	
Construction Cost and pre-operating expense	790.5	1125.6
Transbay Line (tube and approaches)	132.7	178.5
Rolling Stock	<u>71.2</u>	<u>86.7</u>
Total	994.4	1390.8

Source:

- 1 Parsons Brinckerhoff-Tudor-Bechtel et al.
- 2 Leonard Merewitz and Thomas C. Sparks.

Based on data as of April 1, 1971.

II. Co-ordination Among Transit Properties

The CR mentioned but elaborated very little on feeder service. The overall cost of rail rapid transit with feeder bus service is very different from those with kiss-and-ride or park-and-ride collection mechanisms (Meyer, Kain and Wohl, pp. 300-304). I think it is fair to say that BART was planned to rely mainly on park- and kiss-and-ride but over the years of construction the importance of complementary feeder service became evident. In 1964 BART, AC and Muni sought to co-ordinate their service and fares and applied to HUD for study funds. S&C executed most of the study called the Northern California Transit Demonstration Project (NCTDP). In a scenario of how things would look in 1975 AC was seen changing 30 of its 65 bus routes to feed BART. Twelve were eliminated and one added.

Six transbay routes were continued on a much reduced basis while ten were eliminated. Two transbay routes constitute AC's only profit-making activity. S&C foresaw transbay patronage declines more than overcome by the gain in feeder traffic to BART so that more than half of AC patronage became BART-related. The suggested round-trip fare for feeder service by both AC and Muni was 25 cents. Under the recommended route and fare plan AC would lose \$15 million annually and require more than twice the subsidy received in 1965-66 from the property owners of parts of its two counties.

S&C also asked Muni to accept drastic changes. Muni was asked to accept feeder patronage at a loss of 45 cents per vehicle-mile compared to its 1965 subsidy of 31 cents on main lines and 59 cents on

feeder lines (S&C, p. 176). Sixty per cent of all fares in 1975 were making feeder trips to Muni rapid or BART. The loss on Muni would be about \$7 million per year. The Muni rapid proposal was defeated at the polls.

The consolidated operating loss of the three properties was projected at \$1.4 million in 1975. This compared favorably to an annual loss of \$9.5 million Muni and AC were experiencing in 1965 (S&C, p. 206). Meanwhile the AC deficit has climbed to \$5.2 million by 1970 and the Muni deficit supported by property taxes was over \$18 million in each of fiscal 1970 and 1971. John P. Carter had predicted transit taxes of a dollar per \$100 assessed valuation by the early 1970's. This was reached in San Francisco and Berkeley in 1970-71.³ One wonders how much of an increase in transit taxes local property taxpayers will abide.

No legal machinery to enforce co-operation among the transit properties exists. A Metropolitan Transportation Commission (MTC) was created by the State legislature in 1970 with power to deny permission to any public multicounty transit system which uses an exclusive right-of-way and to approve all applications for federal grants to transit systems in the area. It "shall render all available assistance to transit systems operated within the region by any city or public agency to ensure adequate feeder service to public multicounty transit systems," but other than the above, it has no power to ensure adequate feeder service. A hopeful sign was given recently. Under MTC auspices a committee of directors of AC and BART suggested a fare of \$.25 for a round-trip feeder ride, the same as S&C's recommendation. AC representatives also agreed to eliminate bus lines that duplicate BART service

but the particular routes were not mentioned. These tentative plans must be approved by the respective boards; if they are, important regional co-ordination will have been accomplished.

Since AC Transit has the authority and taxing power, we can assume they will continue to run transbay buses.

III. Finance

The CR envisioned construction costs covered by property taxes, transbay tube costs contributed by the California Division of Bay Toll Crossings, and rolling stock costs covered by revenue bonds. Direct costs of operations would be covered by fares. Revenues should also cover debt service on the rolling stock bonds and depreciation. Table 2 shows how actual financing differed from planned financing. The major differences are that a sales tax of 1/2 of one per cent was imposed in the three counties to repay principal and interest on a \$150 million bond issue and that \$125 million of federal support has been forthcoming plus other monies for changes in urban design not contemplated in the CR. Changes in transbay tube financing resulted in BART's undertaking to repay the State for its approaches. Revenue bonds for rolling stock have not yet been issued.

Forecast operating costs have more than doubled since 1962. The CR and NCTDP anticipated costs of \$13.5 and 13.6 million respectively in 1975. BARTD's current estimate in 1972 dollars is 28.5. The CR warned that no inflation was included in its estimates of operating expense. Operating costs foreseen by S&C were 58 cents per car mile in 1967 dollars while BARTD estimates \$1.08 per car mile in 1971 dollars. If we use the average transit industry inflation rate over the past ten years, 3.8 per cent, to inflate both estimates to 1975 dollars, the S&C figure becomes 78 and the BART 121 cents per car-mile. BART research claims that the transit industry average operating cost per car-mile is \$1.32 in 1971. BART costs should be less to the extent that its higher

speed allows it to produce a given number of car-miles in less time, thereby reducing labor costs per mile.

Table 3 gives disaggregated current estimates of operating expense in 1975. A relatively small fraction of BART costs is attributable to conducting of transportation. This item, mainly labor, commonly composes one-half of direct costs: here it is less than one-third. General and Administrative cost is a low fraction, too, for elsewhere it is often 20 per cent of direct costs.

Concomitant with operating expense planned BART fares have risen over the years. Table 4 compares fares anticipated in the CR, the NCTDP and more recent BARTD staff proposals. Final fares have not yet been set. Fares from Berkeley to downtown San Francisco have increased 50 per cent. Those from Daly City to Concord increased 10 per cent. The NCTDP used a fare formula called the "25 + 3", a 25-cent basic fare plus an average of three cents per mile. A final schedule of fares has yet to be adopted although several deadlines for doing so have passed. IBM has been directed to produce fare-collecting machinery according to a "30 + 3" schedule. BART staff had recommended a "30 + 4"⁴ level to the Board, but the Directors opted for lower fares, perhaps to appear magnanimous by contrast with staff.

What will the average trip cost on BART in 1975 if we combine capital and current costs? The basic plant and equipment, aggregating all nonreimbursable costs, has a present worth of \$1339 million. Paying this off at a uniform rate over 40 years with interest calculated at five per cent, yields an equivalent annual payment of \$78 million per year. BART anticipates revenues of \$38 million in 1975 which will cover operating and reimbursable costs. Therefore total costs will be \$116 million per year. Spread over 59 million rides this yields a total cost

Table 2
Sources of Construction Funds for BART

	<u>Composite Report</u>	<u>Plans as of October 1971¹</u>
	\$ millions	
General Obligation Bonds	792	792
Division of Bay Toll Crossings Bond Issue	100	100
Federal Funds		125
Revenue Bonds	71	30 ²
Sales Tax Revenue Bonds		150
Earned Interest		50
San Francisco		32
Berkeley		13.5
Miscellaneous		14.6
Operating revenues for approaches to tube	33	80

1 From Kennedy.

2 No revenue bonds have been issued yet. I believe the availability of federal funds and some uncertainty has made the BART District unwilling to test the skepticism of the revenue bond market. This has limited the amount of rolling stock to be procured. Some plans have been discussed to issue \$30 million in revenue bonds later to purchase 100 vehicles of another sort.

Table 3
 Stabilized Full System Operating Costs
 Fiscal Year 1975-76 in 1971 dollars

\$ thousand

General Manager	405
Administration	2,213
Planning, Public Service	1,172
Operations and Engineering	20,822
<u>Major items:</u>	
Conducting of transportation	5,602
Rolling Stock and Shops	2,152
"Power and way"	5,085
Power	2,896
Materials and Supplies	1,806
Contract Maintenance	1,631
Other	1,563
Contingency	<u>1,309</u>
Total	27,484

Source: BARTD, Office of Research, May, 1971, p. 43.

Table 4
Sample Fares Bay Area Rapid Transit

	CR ¹	S&C ² plan B-4	IBM installation ³
	1962	1967	1971
Berkeley to Montgomery St. (S.F.)	.50	.70	.75
Richmond to Fremont	.85	1.00	1.05
Walnut Creek to S.F.	.70	.85	.95
Daly City to Concord	.95	1.00	1.05
Daly City to Montgomery St.	.25	.35	.40

Source:

- 1 Parsons Brinckerhoff et al., p. 31.
- 2 Simpson and Curtin, p. 159.
- 3 BARTD Office of Research, July, 1971, p. 6.

of \$1.97 per ride, 64 cents coming from fares and \$1.33 from subsidy by property (64), sales (12), and federal taxpayers (10), and transbay motorists (14). Incidence of the subsidy in percentage terms appears in parentheses after each class of payer.

IV. An Experiment in Acceptance of Rapid Transit

The BART system is an important experiment in urban transit. The U.S. Secretary of Housing and Urban Development, Robert C. Weaver, thought it was important enough to campaign for its adoption by area voters in 1962. President Johnson was present at the groundbreaking in 1964. Its goals are broader than to serve existing transportation needs. Weaver justified his intervention in a local issue by saying that his Department had a legitimate interest in urban land use.

Many are watching BART patronage to indicate public acceptance of a high-quality metropolitan transportation system whose capital costs are subsidized. The federal government's \$125 million represents only nine per cent of the BART investment. Projects adopted since 1964 are eligible for a federal contribution of two-thirds of all costs. Thus the Bay Area is paying dearly for its early decision to try a massive investment in urban mass transit. Atlanta, whose citizens approved a \$1.4 billion transit plan in November 1971 expect \$939 million from the federal government. Those funds must yet be appropriated by Congress, however,

Demand for BART rides will be a function of the price of BART and the price of operating an automobile. In order to have a good experiment in the adoption of BART the cost of operating an automobile should be increased. The demand for BART services should not be stimulated by low prices for BART. That would be inequitable and ineffective. It would be inequitable because BART is primarily a commuter railroad (Zettel, p. 33) and its beneficiaries should pay at least its marginal

costs. It would be ineffective. Moses and Williamson have shown that negative prices on public transportation would have been necessary to divert 50 per cent of auto commuters in Chicago in the early 'sixties to public transportation whereas auto trip price increases in the neighborhood of \$.70 could accomplish the same objective. BART quality of service will be different from Chicago public transportation, however.

There is a good case for increasing the price of auto use. Autos do not pay their monetized costs. Douglass B. Lee, Jr. shows that San Francisco spent \$43 million on autos in fiscal year 1971 but collected only \$30 million in its share of the gasoline tax, license fees and in lieu taxes. Further, autos impose social costs for which they do not pay. Each driver imposes congestion costs on other drivers and all drivers impose air pollution costs on everyone who breathes. We do not yet know the magnitude of these costs and we have not begun to impose them on motorists. The analysis of comparative costs by Meyer, Kain, and Wohl does not mention either congestion or pollution costs. Auto trips are assumed producible according to constant costs with no increasing costs due to congestion. Highway space is assumed to expand to prevent congestion.

The existence of BART may make it more practical to impose costs on automobiles used for commutation to San Francisco. When BART needed \$150 million, political opposition to an increase in the Bay Bridge toll was effective. But California has increased the price of gasoline by making it subject to a tax at the sales tax rate. The proceeds are to be used in populous counties for mass transit. Now there is precedent for road users' paying for mass transit. The economic logic is that mass transit makes roads less congested therefore road users ought to share in the costs of rapid transit.

Hopes for diversion of former motorists are sanguine. S&C expected 30.3 per cent of BART riders to be former motorists. This compares with 12.9 on the Yonge Street Line, and 12.5 and 17.5 per cent on the Congress Street Line and Skokie Swift in Chicago.

If anyone hoped for intracity transportation via BART, they were to be disappointed. BART is currently oriented almost exclusively to the East Bay suburbs. It is more like a commuter railroad than urban rapid transit. It serves neither Chinatown nor North Beach, two densely populated residential areas of the city. In downtown Oakland the distance between the Fallon and Fruitvale stations is about 2.7 miles. From Fruitvale to 77th St. is about 2.3 miles.

V. Conclusion

BART planners had a dream. They did surprisingly well in delivering what they had promised. If one were going to misrepresent facts in order to encourage acceptance of a bond issue on a public investment, one would understate capital and operating costs, time to completion and overstate patronage. The BART District did all of these (although patronage data are yet to accumulate) whether intentionally or not we do not, of course, know.

The major benefits of BART are yet to be seen. They will not consist entirely in transportation effects. Land use and urban development goals were of primary importance to BART planners. We can say little about these at the present time save that an interdisciplinary group at the University of California including transportation engineers, economists, city planners and psychologists has organized to monitor the impact of BART on the San Francisco Bay Area for at least the next ten years. Within a decade we should know whether the dream will be realized.

FOOTNOTES

1. The earliest reference I know to this concept is Nathan Cherniak, p. 50 and W. C. Gilman.
2. CR costs were in 1960 prices. The Engineering News Record (McGraw-Hill) Construction Cost Index for San Francisco was 876 in 1960 and rose to 1759 by September, 1971.
3. Transit taxes in Berkeley were \$1.04 including a Special District tax of \$.252, and \$1.19 in 1971-72 including a Special District tax of \$.254. In San Francisco they were \$1.50 and \$1.54 in those fiscal years.
4. The schedules are as follows:

	"30 + 3"	"30 + 4"	"25 + 3"
	cents		
Base Fare	30	30	25
Per mile (4-10 mi.)	4	5	4
Per mile (10-15 mi.)	3	4	3
Per mile (over 15 mi.)	2	3	2
Maximum Fare	105	130	100
Surcharge to transbay trips	4 mi.	4 mi.	4 mi.

Sources: BARTD Office of Research July 1971, p. 5; and BARTD Office of Research July 1971, pp. 4, 36; and S&C, p. 146.

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