ON STUDYING THE IMPACT OF RAPID TRANSIT IN THE SAN FRANCISCO BAY AREA

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Worldwide transport interest centers on the San Francisco Bay Area. At a capital cost of almost $1.5 billion, a decade of major transit improvements, including a new 75-mile rail rapid transit system, will be in full operation by the end of 1972. There is much speculation about what this considerable investment will accomplish. As I understand it, the purpose of this conference is to develop ways and means for studying, in depth and impartially, the total consequences of these transit developments in the Bay Area. This is no easy assignment. The conference plan, for workshop purposes, is to divide the question of impact of the Bay Area Rapid Transit into 4 subject areas:

1. Impact on land use;
2. Impact on travel volumes and flows;
3. Impact on social and environmental characteristics (query: Should these be separate areas of study?); and
4. Impact on the economics of various transport systems and economic and industrial life of the region (query: Should these be separate areas of study?).

Later, I will deal briefly with each of the designated subject areas (though not in the order listed); however, I intend to concentrate primary attention on the second item, which seems most fundamental, at least in the early years of BART operation. If there is no great effect on traffic volumes and flows, there can scarcely be large impact in other areas of concern.

I might observe that this list of study group assignments does not explicitly cover certain subjects that need to be considered. For example, the question of direct costs is not specifically mentioned. The first and most immediately measurable impact of BART and its partners-in-service is the substantial transfer of funds from individuals to the transit operators through fares, taxes, and tolls. The advent of BART and the attendant emergence of planning and operational problems, both within the transit industry and among transit and other modes, may trigger latent forces that will have a far-reaching impact on political machinery. Thus, in drawing up a possible research program, perhaps we should include the impact of BART on political institutions.

These thoughts suggest the dangers of separating impact research into neat compartments for study. Because all impacts are interrelated in some degree, our objective should be appraisal of the magnitude and distribution of the total consequences of BART, both positive and negative. If for operational reasons the research effort must be divided into manageable packages, then provision for overall correlation and evaluation of the results is all the more important.

My basic purpose is to raise questions that need to be thought through. Some of them may seem trivial or even frivolous to an audience of this sophistication. But they need to be asked, for they are kinds of questions that will continue to be debated heatedly in the press and in the legislative halls.

THE BAY AREA SITUATION

It may be of use to the workshops as well as to later impact researchers to set forth a few characteristics of the San Francisco Bay Area, in general, and BART, in particular, that have a bearing on impact research problems. This understanding is particularly important in order to forestall unwarranted transfer of research results to other areas, a practice all too common in transportation circles.

I take it that we are attempting to find ways to appraise a real-world case. We are not dealing with a hypothetical situation or mathematical abstractions. Real trains are going to carry real people over real tracks from real residences to real places of employment and other activities. And all of this is going to happen in a diverse, dynamic, and in some respects unique metroplitan area that will be continuously adjusting over time to many social and economic forces, only one of which will be the advent of a 75-mile rail system in 3 of the 9 Bay Area counties and with a potential service area of approximately one-half the Bay Area population.

The Bay Area

The Bay Area now has nearly 5 million people and 2 million jobs dispersed over 7,000 square miles of land and divided by large barriers of water and mountains. Yet the San Francisco-Oakland complex has one of the most concentrated urban core developments of any large metropolitan area and also many low-density suburbs. Diversity is extreme and must be reckoned with in development of the total urban transportation system. Santa Clara County (not served by BART), fastest growing and almost certain to be most populous, is in many respects more like Los Angeles than San Francisco itself. On the other hand, "the city" (little more than 40 of 7,000 square miles) is something of a Manhattan of the Pacific, having little likeness to other western cities and having a unique political structure that leads some to call it a duchy and others to suggest that it be fenced off as a state historical monument.

The overall shape of the Bay Area's development owes much to the presence of the Bay and the mountains. Physical features constrain a narrow bay plain, which, for a distance of about 100 miles, now contains bands of virtually uninterrupted urban development on either side of the Bay. These corridors fix the direction and location of the major streams of urban travel at the central core of the region and strongly influence the circulation of persons and goods toward the developing periphery. Topography has served to constrain a large part of the growth along existing and predictable paths.

Outside the core, the bay plain is characterized by linear pockets of industrial activity along the bay front. In the rest of the region, the pattern has become one of suburban development in a number of subcenters joined by urbanized corridors of land. In the largely undeveloped hinterlands, cities are generally small and self-contained.

Transportation Characteristics

The transportation system that has developed, and is in current development and planning, follows the corridor configuration dictated by the region's natural features. The Bay itself is a formidable barrier requiring that traffic be funneled to major crossings for east-west travel and north-south travel (on the west side) leading to heavy volumes in narrow confines that appear, on the surface, to lend themselves readily to transit movements.

An inspection of transport networks elsewhere suggests the Bay Area's uniqueness. Regions such as Boston and Washington, D. C., have a wheel-and-spokes pattern in their transport systems. Chicago has radial spokes superimposed on a grid of freeways. Los Angeles has primarily a grid pattern. None of these resembles the San Francisco region, where many of the principal routes run doughnut-shaped around the Bay, and crossings of the doughnut hole are spread farther apart than they would have been over land. The particular Bay Area pattern tends to concentrate major travel flows in main corridors and to emphasize "gateway" transportation needs and problems.

It is significant that the 75-mile rail rapid transit system now abuilding is designed to serve this pattern. Essentially, it intercepts 4 gateways—in the East Bay from the north, east, and south and in the West Bay from the south. The 4 arms of the system follow major corridors already served by freeways, and the Bay is crossed at the point of heaviest traffic concentration. The system is primarily serving built-up areas. According to one estimate, 87 percent of expected patronage in 1975 will be destined for existing employment centers (downtown San Francisco, Oakland, and Berkeley), and 86 percent of the riders will come from already built-up residential areas.

This, then, appears not to be the planners' dream. It appears not to be a system that would shape the area into a radically new pattern of urban development, but rather one that would tend to maintain the status quo within the 3 counties and for half the population of the Bay Area served. According to Simpson and Curtin:

> BART will be a different transit service on the two sides of the Bay, just as the attitudes and aspirations of these communities are different In San Francisco, it will be a fast trunkline to downtown, in Berkeley and Oakland, an alternate to traffic congestion on the Bay Bridge to San Francisco; and in Fremont and Concord, a realty catalyst .

The Voter's Decision

The rail rapid transit system that will be in full operation by the end of 1972 was brought into being by a vote of the people in 1962 through approval of a general obligation issue amounting to $792 million that, together with interest, is to be paid entirely from taxes on property within the 3 counties. Other financing, including federal aid, bridge tolls, and retail sales taxes, will raise the total capital cost to about $1.3 billion, none of which is expected—nor ever was intended—to be paid by users of the system directly. It is hoped, however, that expenses of maintenance and operation and capital costs of rolling stock can be met from fare-box revenues.

The subsidy to BART, approved by the voters with foreknowledge, will be substantial. In effect, it was decided that the direct benefits of the system to its potential users would not be sufficient to induce them to meet the full costs of the system. Justification for the subsidy will have to be found in other beneficial impacts of the system. One of the objectives of the programs developed in this conference might well be to ascertain, if possible, whether gains to the community as a whole in terms of transport service, economy, ecology, land use patterns, and social values warranted the total investment.

BART's Promises

Obviously, the voters held great expectations. Before the Bay Area Rapid Transit District was formed, they were told that an interurban rapid transit system "integrated with the programmed arterial highway network, is not only the best but the least-cost solution to the region's total land development and transportation problem." Also, "that without rapid transit the region will ultimately pay many times its cost in additional hours of travel time, in the additional cost of trucking goods over highways congested by automobiles, in diminished revenues from property depreciated by congestion or swallowed by automobile facilities, and in the premium costs of urban freeways and parking garages." And, "the development of nucleated centers and subcenters is possible only if these are served by a high capacity transportation system integrating freeways and rapid transit. To depend on highways alone is inevitably to choose the alternative of dispersion."

Just before the election, the benefits of BART were listed for the voters in BARTD's Composite Report, as follows:

1. It would aid future growth by (a) maintaining and encouraging concentration of business and industry and lessening sprawl, (b) improving living and working conditions, (c) preserving and increasing property values, and (d) permitting more economic use of land.
2. It would benefit state and local governments by (a) reducing the need for highway funds in the central cities and releasing them for suburban areas, (b) containing urban sprawl thereby lessening costs of public services, (c) protecting and increasing public revenues by inducing greater economic growth, and (d) reducing usurpation of tax and job-producing lands by highway facilities.
3. It would benefit families and individuals in the 3 counties by (a) increasing mobility and job potentials of users, (b) providing transportation for those without automobiles, and (c) expanding social, educational, and recreational opportunities.

In concluding the piece on benefits, the consultant said:

> With the great growth of population, employment, and travel which lies ahead for the Bay Area, the influence of rapid transit in establishing efficient travel patterns—and the system's large reserve capacity to absorb growing volumes of traffic in the foreseeable future—would make rapid transit an invaluable tool for aiding the area's economic growth, and for creating conditions for a high standard of metropolitan living.

But despite the assertions, few of the promised benefits could then be quantified; the question now is whether studies of impact after the system is in operation can be devised to successfully measure gains and costs.

Since BART has been abuilding, additional claims have been made. For example, in 1968 it was stated that "the advent of BART has triggered a building boom exceeding all voter expectations." Again, "The advent of BART will inexorably and positively broaden and create new choices in employment, housing, recreation and education." In 1969 a report entitled "BARTD and the Ghettos" pointed out that 24 of the BART stations "effectively and dramatically serve designated poverty areas." It was noted also that "the Bay Area can expect a three-county rapid transit system which virtually eliminates student dependence on the automobile."

There is something rather refreshing in the last report that may have considerable bearing on the impact of BART. Instead of blunt assertions of automatic, inevitable benefits of BART, there is recognition that BART's impacts will depend in some circumstances on conscious policy action. It is noted:

> Precisely how well the political and economic leaders of the Area will use the BART lines and stations for the benefit of the blue-collar and white-collar workers alike is not a known fact It is a matter of speculation. It can also be a matter of disillusionment if opportunities are ignored . . Effective use of BART and surface transit for social purposes will require a regional point of view in the routing of public transit lines More significantly, a unified attack on the problems of unemployment could result in new industries and businesses being established near BART stations . . Creating job training of specialized education centers near BART stations is yet another challenge that can be met realistically by regional leadership

These are interesting thoughts regarding impact; not that BART will inexorably cause something to happen, but rather that BART's existence may stimulate Bay Area leadership to cause things to happen.

This recital of some of the hopes held within the Bay Area regarding benefits that will accrue because of BART suggests kinds of questions that need to be dealt with in impact research.

INTEREST IN BART IMPACTS

Interest in BART's potential impacts extends far beyond the Bay Area. The Oakland Tribune recently observed: "From Moscow to New York, urban planners and transportation experts will be watching BART's progress. These persons have also dreamed of trains and sophisticated equipment capable of doing the things BART has promised the residents of Alameda, Contra Costa and San Francisco counties. . . . Once the trains carry passengers, urban planners will begin taking notice."

A National Concern

Simpson and Curtin stated: "Nationally, BART is a billion dollar experiment to determine whether the highest and best application of transit can lure commuters out of automobiles." It should be an experiment to do more than this. It should help us to appraise the total impact of a considerable infusion of transit investment on urban life. We need to ascertain, if we can, whether hoped-for benefits actually materialize, how they are distributed, and how they compare with total costs and their incidence.

The BART area owes something to the nation; nowhere else to my knowledge has the federal government invested over $100 million for a total new and admittedly experimental

system. If it is to be useful to others, however, impact research will have to be carefully done. The characteristics of the Bay Area and the circumstances of BART's operations will have to be constantly recorded so that inferences regarding BART impacts will not be casually and mindlessly transferred to other urban areas.

Bay Area Concerns

Impact research is much more than an "after the fact" study as far as the Bay Area is concerned. Grave questions remain as to future extensions of BART, not only within the 3-county area but to other counties of the Bay Area. There are difficult decisions to make regarding other transport facilities, most importantly freeways and bay crossings. Already there is considerable sentiment for delaying a southern trans-Bay crossing (now in active design) until the full impact of BART is known. How to know and evaluate this impact, even when the system is in operation, is going to require more rigorous analysis than most people imagine.

The controversy currently raging over the southern crossing dramatically suggests the extent of confusion presently prevailing in the Bay Area. It also suggests the possibility that public actions may be taken to ensure that BART's impact on traffic will be greater than it otherwise might be. Policy desisions of this kind should be monitored and explained if a frank appraisal of BART's impact is to be presented. One might think we would now have more consensus concerning BART than we have. If we do not have full understanding of potential impacts on land use, on social and environmental characteristics, and on economic development, at least we should have reasonable agreement on probable usage during the early years of operation.

Actually, a number of travel studies have been made. Prior to voter approval of the system, patronage estimates were prepared and disseminated. The Northern California Transit Demonstration Project, jointly sponsored by the 3 agencies with federal aid and conducted by Simpson and Curtin, prepared estimates of daily transit trips on BART, A. C. Transit (A. C.) and the San Francisco Municipal Railway (Muni) for 1975. More recently the Bay Area Transportation Study Commission completed its report that included estimations of transit patronage for 1980 and 1990. These estimates are all based on quite similar techniques of transport analysis, including the modal-split procedure. The differences in results are not large enough to be of great significance in analysis of broad issues. The fact is that none of the results is accepted by some who have high hopes for rapid transit's impact in the Bay Area.

The Simpson and Curtin report, for example, estimates that the 3 transit agencies will carry 673,000 adult transit trips per average weekday in 1975. This about 26 percent more trips than were carried by transit in 1965—a considerable increase but not so significant when compared with a 20 percent increase in population in the area served by the 3 systems. In all research on BART impact, it must be remembered that the area served already has transit service that might have continued to grow in the absence of BART. BART's main source of patronage will be riders who have been diverted from other transit systems.

BART's patronage is estimated to be 241,000 adult passengers per day in 1975, but transit ridership on the other 2 systems is expected to decline by about 103,000. The greatest impact is expected to be on Bay Bridge traffic; BART and A. C. together are estimated to carry about 75,000 adult passengers per day in 1975 as compared with 42,000 carried by buses in 1965, an increase of 81 percent. BART is expected to divert 21,000 trans-Bay automobile person trips to transit in 1975. In terms of peak-hour, peak-direction usage, this transit diversion is estimated to be the equivalent of 3,200 automobiles and a number of buses—roughly 2 lanes of highway capacity.

These are significant numbers, but they hardly suggest a staggering impact on traffic flows or an enormous rearrangement of urban living patterns. If we make extreme assumptions (a) that transit usage would not increase between 1965 and 1975 without BART and (b) that all trans-Bay and East Bay adult transit trips by BART estimated to be diverted from automobiles would be journeys to and from work, about 21,000 workers, out of a work force of nearly a million, in the area served by BART in the two east Bay counties would be involved in 1975. When figures like these, inflated

though they may be, are scattered over the 3 East Bay arms of BART in an area that is growing rapidly, it should be no surprise that many observers do not expect miracles from BART.

Estimates of this kind based on present techniques of traffic analysis, however, are rejected in many quarters. BARTD's general manager generally dismisses them as based on mathematical models that fail to reflect the true drawing power of the BART system. Mayor Alioto of San Francisco is now reported to be in favor of delay of the southern crossing and is quoted as follows: "Rather than taking a wild guess at whether the new crossing will be needed, we should wait to see the effect of BART before going ahead." In contrast, State Senator Lewis F. Sherman, presumably a supporter of another trans-Bay crossing for motor vehicles, is reported to have said: "Opposition to the Southern Crossing is based upon mere speculation that there will be a mass shift from autos to trains of the Bay Area Rapid Transit System."

It is ironic that only now—some 8 years after the matter was before the electorate—the question of BART's potential patronage is being seriously debated in public. If the issues cannot be resolved now—and I suspect they cannot—perhaps well-conceived impact research will provide a basis for improving and imparting confidence in transportation analyses in the future, particularly as it pertains to the modal-choice problem.

Impact Research and Transportation Planning

In the study of BART's impact, there will be other things to look for that may be useful in reappraisal of techniques of transportation analysis and planning. In fact, certain assumptions made in the BATSC reports (and I believe this to be true of other major urban transport studies) tend to deny the very possibility of certain kinds of impacts resulting from the operation of BART.

First, estimates of regional growth of population and employment were prepared without regard to levels of urban transport service that would be available. Possible transportation deficiencies were not regarded as a restraint on growth. Second, locational models assumed accessibility to all places of potential development for residence and employment. Third, future person trips were generated based on estimated changes in socioeconomic characteristics of households but without regard to nature and quality of the transport services offered and were distributed between production and attraction areas using a hypothetical network that might meet potential demands. Moreover, the modeling techniques made no provision for impacts resulting from disequilibriums inevitably arising during the course of unavoidably providing transport improvements sequentially.

These were heroic assumptions based on the thought that the transportation system is to serve, not to shape, the area and its travel habits. In effect, however, they asserted (a) that regional growth will not be affected at all by BART, (b) that location of activities as to the region as a whole will not be affected to any major extent, and (c) that person trip generation and distribution will be the same, regardless of the mix of highway and transit facilities or the order in which they are provided.

I should hasten to note that BATSC's analytical mechanisms were developed so that alternative assumptions regarding land use and transportation patterns could be tested. The "controlled trends plan," reported to the legislature as an initial exercise, reflected a continuation of current trends and policies that, of course, could be modified by policy intervention. It was emphasized that there existed neither a general regional plan nor any statement of comprehensive regional goals to which transportation plans might be fitted. Moreover, the BATSC findings were not represented as the plan for the Bay Area but as a development guide. Much attention was given to the need for a continuing transportation planning process that, in fact, is now being carried forward under a new organization that has taken over BATSC data and analytical capability.

The point to be stressed here is that the continuing transportation study and planning process can make a major contribution to impact research through its data base and processing and analytical capabilities. At the same time, however, effective impact research may lead to more realistic assumptions and improved techniques of urban transportation analysis and planning. In a broad sense, an impact study might be approached as an exercise in transportation planning and analysis after the fact.

Difficulties of Impact Research—An Overview

As in all studies of urban phenomena and human behavior in the real world, meaningful results of impact analysis will not come easy. None of the economist's "other things" will stay equal. Cause and effect may run in circles. Different impacts, if they can be identified and measured at all, will be manifested over different periods of time.

One possibility is that BART's impact may run through cycles. After its initial impact, which may be less than many expect of it, there may be some disillusionment with transit and renewal of interest in highway development. But this could run its course, and attention could again be turned to effective utilization of the very substantial reserve capacity that will probably exist in the BART system. Some observers believe this ability of BART to expand operations in its service area without change in its basic plant may be its greatest asset over the long run.

A number of possible research techniques should be explored. The first that comes to mind are before-and-after studies. But, how long before, how long after? For example, BART has been cited as a "major catalyst" for a downtown commercial building boom that is taking place in San Francisco. Whether BART is cause or effect, it would be ironic if the building boom tapered off after BART began operations, not because of BART but because the BART impact had been anticipated before its operation. But the larger question is whether BART in any way caused the boom; or, on the contrary, did foresighted business leaders, seeing the need for expansion of their facilities, cause BART to come into being? Whichever way it was, would an extension of BART in other directions, say, down the peninsula, result in or be accompanied by another building boom of similar proportions? Or have Bank of America, Pacific Gas and Electric, and other major developers anticipated their needs for a considerable time in the future? Consider here that their needs are not generated by regional demands but may be statewide, nationwide, or even worldwide in origin.

Before-and-after research might be partially misleading even in the matter of traffic diversion. Have a significant number of people already anticipated the advent of BART's operations and chosen their residential or job locations accordingly, and are they commuting via bus or automobile until such time as BART offers service? If so, impacts on travel flows and land use will have been exerted before BART.

What are the difficulties of impact-area versus control-area research? How does one establish comparable areas where the critical variable is the existence or nonexistence of rapid transit? To be considered also is the possibility that the control area is affected by development in the impact area. For example, in the Bay Area a significant BART impact in the East Bay in regard to the attraction of residents and jobs might have adverse repercussions on the West Bay Peninsula.

Can we conduct realistic "with or without" research? Should we consider how other transportation facilities and services might have developed had the 3 counties not made the commitment to BART? For example, the Simpson and Curtin report estimates a loss of 103,000 riders on A. C. and Muni between 1965 and 1975 and ridership on BART of 241,000 for a gain of 138,000 transit patrons. But if A. C. and Muni had simply increased ridership proportional to the increase in population, their ridership in 1975 would have been 642,000, only 31,000 less than the estimated daily patronage of these systems plus BART. What the numbers say is that while population increases 20 percent transit ridership increases 26 percent, some of which will be caused by multiple use of transit for a single trip.

What is the net impact of BART? The words, "what might have been," said to be the saddest words of all, may also be the most unresearchable. A bell cannot be unrung; the commitment of resources to BART cannot be disregarded. Insofar as 3 counties of the Bay Area are concerned, the capital cost of BART is sunk (raising questions to be discussed later), and this fact is bound to have an impact on policy decisions—those that have been made in recent years, those that are currently being made, those that will be made in the future when BART is in operation. The decisions may be economically sound and politically rational, but they must be ferreted out and dealt with if we are to understand the true impact of BART.

SPECIFIC CONSEQUENCES

Impact on Traffic Volumes and Flows

I noted earlier that BART's impact on traffic volumes and flows seems to me to be the starting point for impact research. Only if there is significant impact here will there likely be major impacts on the economies of other transport modes, on land uses and values, and on environmental and social characteristics.

Changes in volumes and flows should be comparatively easy to identify and measure. Moreover, well-structured research in this area may provide considerable insight into other consequences of the BART operation. If this is to be done successfully, provision should be made to include in data surveys of trip-makers the kinds of information that will be useful in appraisal of impacts on land use and social and environmental conditions. Even if separate analysis is feasible, data collection should be comprehensive.

As a starter, I think we would want to get much information about BART riders. We would want to know the origins, destinations, and purposes of their trips. We would want socioeconomic information about their households: incomes, occupations, automobile availability, family composition, household type. We would want historical data, too: whether the trips in question were made prior to BART and by what mode; whether residences or job locations, or both, had been changed and the specific nature of the changes; whether BART was a factor in making decisions regarding such changes.

At the same time we would want to know much about those who continue to use highways for urban travel purposes, especially journey-to-work trips. We probably would want to separate the highway users into 2 classes. In one group would be those who continue to use highways even though BART seems to offer them a reasonable alternative as evidenced by comparison with those who actually use BART. What we would like to understand is the basis of behavior among the so-called choice users—those who choose to use BART even though they might use automobiles and those who use highways even though they could use BART.

The second group of highway users to be studied consists of those who travel within the BART service area and even follow corridors and go through gateways served by BART but who do not use it. For one reason or another, perhaps because their actual origins or destinations are not conveniently served, BART offers no reasonable alternative. This group of users needs to be clearly identified and its basic requirements explained. Far too often the casual observer, seeing striking contrasts between congested freeways and unused transit capacity (which will be especially obvious in the Bay Area), will conclude that only the perversity of the motorist stands in the way of greater transit usage that will contribute to quality of life. What is overlooked is the inherent flexibility of the automobile over the length of the journey to which users have become habituated and to which they have adapted their life styles.

We will need to keep all of this in the perspective of total travel demands, neither to denigrate transit nor to extol freeways but to understand the overall picture. Unless we completely miss our guesses, automobile travel will continue to dominate the total urban travel scene. In the 3-county BART area, transit accounted for about 9.3 percent of all person trips produced in 1965 (19.6 percent in San Francisco and 4.6 percent in Alameda and Contra Costa Counties combined). According to BATSC estimates, transit will account for a lesser percentage of total person trips in 1990 than 1965 (8.6 percent in the 3-county area), notwithstanding a 50 percent increase in transit trip production. But we should acknowledge that comparisons of total daily trips standing alone no more reflect the importance of transit than do peak-hour trip comparisons alone reflect the full value of highways. Both must be considered.

It is generally conceded that transit's large contribution to solution of the total urban transportation problem will be found in its peak-period patronage, provided largely by commuters who account for only about 1 out of 5 daily trips. Already A. C. Transit is carrying about half the persons that travel across the Bay Bridge at peak hours; BART will do better and therein will lie its value. However, a word of caution is in order here lest there be disillusionment through superficial analysis of BART's impact on

peak-hour congestion. There is an established tendency for traffic peaks to spread over time as congestion increases and to compress as congestion eases with a resulting sharpening of the peak. It could easily happen that, as BART relieves the bridge of some vehicular traffic, highway travelers will adjust to the new situation so that peak-period congestion will seem as great as before even though compressed into a shorter time span. Even if this happens, however, the peak users will have benefited because they will have chosen times of travel more nearly in accord with their desires. This point might easily be overlooked in casual observation or superficial study of BART's impact on traffic volumes and flows.

Impact on Economics of Urban Transport Facilities

Much support for BART stems from the hope that its operations will minimize the total costs of urban transportation, both by providing a less costly alternative to the automobile and by directly reducing the costs of the remaining highway travel. The extent of any cost reduction will be related, of course, to BART's success in attracting patronage through the immediate diversion of traffic and perhaps over time by rearrangement of land uses in a manner that will reduce demands for highway service and encourage use of transit.

Highway Facilities—Savings in cost of highway transport may be manifested in 2 ways. For those who continue to use highways, congestion costs would be reduced by diversion of motor vehicle traffic to BART. This argument was persuasively used to justify the allocation of motor vehicle tolls on the Bay Bridge to the construction of BART's trans-Bay underwater tube. Both monetary and other costs might be reduced by lessening congestion. As to the former, highway users would have resources to spend for other things or for more travel. Most of these savings, however, would probably accrue through greater comfort and convenience and through time savings, which not only are difficult to quantify but never show up in disposable income. If indeed demands for highway travel are reduced significantly, it follows that the need for highway facilities should be reduced concomitantly and, in turn, the burden of highway-use charges should be lessened. Much point was made of this possibility when BART was presented for public approval. The controversy involving the need for the southern crossing is an immediate case in point.

From the transit viewpoint, there is a rather paradoxical note in the potential impact of BART on highway travel costs; if the costs of highway transport are reduced or the benefits enhanced, the relative attractiveness of the transit service is thereby diminished. It is common knowledge that many people in the Bay Area regard rapid transit as something for "the other fellow." They see it mainly as a means for improving the quality of their own highway travel. An additional possibility is that, if there is a significant diversion of highway travel, the overall quality of urban transportation will be so improved that the total volume of travel will increase with the result that diverted highway travel is offset in some degree by induced travel—travel that would not have taken place in the absence of the transit improvements. This gnawing little possibility might be stored away conveniently for academic research on BART impacts were it not for the fact that counteraction might be taken to discourage any tendency for highway travel to increase. This could be accomplished by increasing motor vehicle taxes or tolls, or even more easily by simply refusing to permit improvement of any potentially competitive highway facilities. Until very recently, any possible hostility between highway and transit supporters has been rather easily camouflaged by the comfortable shibboleth that both highway and transit facilities are needed, which will happily complement each other once that indefinable something called balanced transportation has been achieved. We may be approaching a moment of truth.

It is foolish to deny that an improvement of highway facilities in corridors served by BART is likely to have an adverse impact on BART's patronage and its revenues. The more congested the highways, the fewer the additions to highway capacity, the better it will be for BART. On the other hand, to allow the costs of highway congestion to continue or to build up simply because BART exists can scarcely be regarded as rational economics.

The hard question is not whether a highway improvement adversely affects BART but whether the benefits of improvement outweigh the costs, including the costs of an adverse impact on BART. From the public viewpoint the matter of incidence of benefits and costs (who gains and who loses) both within and among highway users, transit users, and other groups and individuals in nonuser roles is important. In particular, consideration should be given to highway uses for which transit offers a decidedly inferior alternative (many of the nearly 80 percent of trips that are not work trips) or no real alternative at all (goods movement and person trips whose origins and destinations are far removed from transit facilities).

Transit Facilities—Once a decision has been made to subsidize transit service, there is little that conventional economics can tell us about the value of the service. We can, of course, call up some popular bromides: overriding social considerations, cleaner air, lesser external costs, more desirable land use patterns, happier living conditions, and higher quality of life. We have little, however, that we can measure by any standard and even less that we can translate into monetary terms. It is hoped that this conference can suggest ways to get a grip on some of the these matters, so that our impact research will lend objectivity to what otherwise will be purely subjective judgments jelled in the political arena.

Whatever the benefits of improved transit services are judged to be, they must be set off against direct costs. Leaving aside subsidies for the moment, we might note that Simpson and Curtin estimated transit revenues (costs to the users) of the 3 public systems to be about $72 million in 1975 (under their assumptions regarding potential patronage and optimal fare structures) as compared with revenues of $33 million in 1965. Thus, direct transit costs to riders will increase almost 120 percent as compared with a 26 percent increase in the number of trips taken by passengers. Although they will be different and better, the trips will each cost substantially more. Economic reasoning tells us that the benefits to users will equal or exceed these direct costs because the riders are willing and able to pay the fares. It is still worth noting that disposable income of this magnitude is being transferred to the transit operators. The assertion usually is that those riders who will have been diverted from automobiles will experience direct cost savings, but even this matter will deserve careful study.

The substantial transfer of resources to transit through taxes and tolls will also deserve careful study. For example, the Simpson and Curtin report forecasts operating deficits in 1975 of $5 million for A. C. Transit and $7 million for the San Francisco Municipal Railway, a total of $12 million. The hope is still held that BART will be able to meet its expenses and costs of its rolling stock from its fares; but, the capital costs of the fixed system will all come from external sources—property taxes, sales taxes, bridge tolls, and federal aids, some of which will have been "prepaid."

I have not attempted in this paper to prepare careful estimates of annual cost, but it might be noted that service of general obligation bonds in 1975 were estimated to require about $40 million, which should now be increased because of higher interest rates. An early estimate of annual costs of $42 million for BART alone would now be considerably higher because of inflation, higher interest costs, and additional nonrevenue financing that has been arranged. Something approaching $100 million might be regarded as a rough approximation of annual capital costs. For the 3 systems, the amounts of subsidy will exceed the amounts paid by the riders.

One of BART's immediate impacts will be its effect on the operations of the existing transit systems. It is anticipated that Greyhound Bus Lines, which serves parts of East Bay not served by A. C. Transit, will discontinue operations and will be happy to do so. Not so with other systems. They will continue to operate, but their roles will be changed. It is estimated that nearly two-thirds of all trips to and from the BART system will take place on the present surface lines, A. C. and Muni, thus involving troublesome transfers and problems of fare structure and collection. Many patrons now paying one fare for a transit trip will find themselves making transfers between systems and paying two or more fares, one to A. C. or Muni and one to BART.

A. C. Transit will be expected to so adjust its operations that it will contribute to the success of BART. On the one hand, it will be expected to provide optimal feeder service to BART stations; on the other hand, it will be expected to discontinue operations

where they are in direct competition with BART. A. C. Transit is estimated to carry 57,000 adult passengers per day in 1975 as compared with 125,000 in 1965, a reduction of more than half, notwithstanding the growth of the area. There is an estimated reduction of 38,000 riders in the East Bay (over 40 percent) and about 30,000 in trans-Bay operations (almost 90 percent). Moreover, A. C. operations in the East Bay will carry more than half of the passengers to or from a BART station, according to the Simpson and Curtin estimates. Financial problems will arise, and A. C. Transit will lose its profitable lines and assume an increasing number of deficit-ridden feeder operations.

The real question is whether operation of the 2 systems can be optimized under separate managements. Will each attempt to minimize its own deficit or maximize its revenues to the detriment of the other? Unfortunately, the boundaries of the 2 public districts are not conterminous, and the difference in constituencies may aggravate the difficulties. Quite obviously those who live and pay taxes in both districts will want the kind of optimization of the combined systems that minimizes the combined tax bite. But what of those who live outside the A. C. Transit district? Their concern with BART's welfare may not be so magnanimous as to include A. C. Transit. The institutional difficulties are of sufficient gravity to have led already to suggestions for a merger of the systems. For example, Mayor Wallace Johnson of Berkeley, on the recent occasion of resigning from the BARTD directorate, stated.

> The realities are that . A.C. Transit is financially dependent upon its profitable transbay runs to offset its unprofitable East Bay service. .BART's operational success is based on taking over 90 per cent of A.C Transit's transbay patronage . (It is) time for the Legislature to force a merger of BART and A C Transit which could economically serve the citizenry.

The Muni picture is also murky. It is estimated that the Muni will lose almost 30,000 adult passengers per day between 1965 and 1975, even though it will pick up transfers to and from BART. However, the impact of this loss is not nearly as great as that of A. C. It is estimated that Muni will still carry about 353,000 adult passengers per day in 1975, which—not at all incidentally in connection with impact studies—is about 10 percent more daily passengers than BART and A. C. together are expected to carry.

The Simpson and Curtin report, however, based its estimates on the heroic assumption that Muni would have a rapid transit system as well as a surface system by 1975. It was estimated, in fact, that 199,000 of Muni's 353,000 passengers in 1975 would be on its own rapid transit. The recommended rapid transit network would include 3 new rail rapid transit lines (in addition to BART's line to Daly City) as well as new express bus services on freeways. Costs would range from $310 to $400 million. The plain fact is that the proposed rapid transit system will not be in operation in 1975, and perhaps not even started. The Muni is struggling even now merely to replace its obsolete equipment and to provide cars that can operate on its level of the Market Street subway furnished by BART.

Digressing slightly, I might note that difficulties in financing the Muni will have a direct bearing on the financial feasibility of extending BART to the northern and southern peninsulas. San Francisco is already destined to bear a substantial continuing property tax burden for support of the initial BART system. If and when a rapid Muni is built, an additional burden will be imposed. San Franciscans will not be kindly disposed to share any part of the cost of extending BART into either Marin or San Mateo Counties, even though somewhat ironically these counties have the largest share of resident workers commuting into San Francisco. It will be even more difficult to engender support in the East Bay for sharing in costs of any BART extensions emanating from San Francisco to West Bay communities.

There is need for some kind of regional intervention. Two of the rail rapid transit lines recommended for the Muni reach toward San Francisco's northern and southern neighbors. It would be a sad circumstance, indeed, if Muni rapid were instituted but institutional barriers stood in the way of full exploitation of potential opportunities for

extended transit service, particularly in the Marin corridor. But this is a future problem. During the early years of BART operations, it is safe to conclude there will be no Muni rapid service of any kind. I have found no data on the effects of not having the Muni rapid—either as to the impact of BART operations on Muni's patronage or as to Muni's impact on BART operations without its own rapid transit component.

As to our own area of concern—overall impact of BART—the ramifications are broader. For example, a considerably improved Muni service might hold or encourage residents to stay within the city (and exert other influences on land use); in the absence of such improvements, they might locate elsewhere, perhaps influenced by the availability of BART. Clearly, policy actions or inactions may have much to do with the nature of BART's impacts, both in the short and long run. Repugnant though the idea is, an unimproved Muni could be to BART's advantage as an independent agency, just as unimproved highways might be. The question is whether BART's interest necessarily coincides with the interest of the community-at-large; and if it does not, how differences are to be resolved.

Regarding the economics of BART's own operations, the significant fact is that costs of the fixed plan are sunk. Even in a strict economic construction, only the variable costs of operating and maintenance expenses (costs that vary with patronage) are relevant in the setting of fares. Here then is the classic case for the welfare economists—the situation in which marginal revenue (the fare) may be appropriately equated to marginal cost without being bothered by the problem of covering fixed costs. (I am assuming here, of course, that BART will not be so enormously successful that its carrying capacity will be so taxed within the next decade or so that "congestion costs" will arise and lead to proposals to ration BART rides through efficiency pricing. But perhaps I will be allowed to be impish enough to suggest that, if BART is as successful at the turnstiles as some of its enthusiasts hope, perhaps a moderate contribution to relief of the property taxpayers who are footing the major bill for the fixed costs would not be totally unthinkable.) Even this need not follow, however, if we reject economic tests. If we have found (or think we have) the impacts of BART in terms of social, environmental, or land use consequences to be sufficient to justify subsidy for capital costs, might they not also be sufficient to justify subsidy for the variable costs? Senator Sherman has recently proposed "free" trans-Bay bus rides on the A. C. system (the costs to be covered by vehicle tolls); is it unthinkable to consider "free" BART rides also? Indeed, if zero fares were put into effect now, there would almost certainly be an organized drive to continue the practice into the BART area of operations.

Whatever may have been decided in the past or may be decided in the future about BART's financing and fare policies will affect the magnitude and incidence of BART's impacts on the community, and should be considered in any appraisal of extensions of BART within the Bay Area or the construction of new systems elsewhere. When extensions or new systems are planned, total costs, not simply variable costs, are to be set off against the estimated beneficial consequences.

Federal or State Aid—In this connection, perhaps it is appropriate to restate an obvious danger. Any large-scale program of federal or state aid for urban transit runs the risk of distorting investment decisions simply because the benefits, whatever they may be, are almost entirely localized, but the aid (costs) comes in large part from abroad. There is an understandable tendency to compare total benefits to the community with only that portion of the costs that must be raised locally; the "external" financing is "free."

Perhaps the $100 million or so that the federal government has supplied BART can be satisfctorily rationalized as an acceptable national contribution to a billion-dollar experiment. But if the federal government is going into transit financing in a serious way, it should insist as a condition of its participation that all impacts be considered—the external as well as the internal, total costs as well as total benefits—in order to guard against unwarranted investment nurtured by "free" money. There is yet another consideration from the national viewpoint. A development ensuing from transportation improvements that may be regarded as salutary from one metropolitan area's point of view (for example, the attraction of additional growth) is not necessarily beneficial to the nation as a whole; there is much likelihood that the development may have been bought

with federal aid at the expense of other metropolitan areas. I am not, of course, singling out transit for special concern. I am just as concerned about federal aid for highways that tends to distort investment decisions and is often justified on the basis of benefits that are real for localities but illusory for the nation. We should insist that both highway and transit improvements be subjected to the same tests, and that these tests not be warped by the availability of federal aid. Whether it be federal aid, state aid, local taxes, or a combination of these, so long as there is subsidy to transit, the justification for it must be found beyond the realm of conventional economics.

Impact on Quality of Life

Many of the early hopes for BART could not be translated into monetary terms but were to accrue through improvement of land use arrangements and environmental and social conditions. In today's world it would be argued that BART would improve the quality of life. How are we to measure BART's impact in improving quality of life or changing life styles for the better? I suggested that some grip on questions of improved quality might be had simply by analyzing the nature and characteristics of changes in traffic volumes and flows. With this in mind, we should design data surveys of transit and nontransit users to incorporate information that will assist in appraising impacts on land use and social and environmental conditions. Costs as well as benefits must be considered. Too often, one side or the other of the equation is ignored, and net results cannot be determined. This holds for quality-of-life impacts as well as more conventional tests; if we acknowledge that certain benefits cannot be quantified, we must admit that certain costs also cannot be quantified but are real nonetheless. Unfortunately, the great difficulty in all of this is absence of consensus on overall goals of the region against which the various impacts of BART might be set off to determine whether, on balance, they are beneficial or detrimental.

Land Use—Land use planning theory tells us that changes in relative accessibilities of land locations will shift demands and affect site values, so that changes in land use will take place over time. If values are higher at the more accessible locations, we should expect more intensive development of the land (higher densities). There is some question, however, whether incremental changes in the urban transportation system are as influential in changing land uses as they were once thought to be, and perhaps actually were before the automobile introduced so much flexibility. Perhaps impact research will give insight to this question. In any event, BART's impact on land use may be rather difficult to isolate. In comparison with the whole, it is a comparatively small system; moreover, it is primarily serving areas that are already developed and are expected to retain their basic character.

I understand that significant changes in land use are taking place in many metropolian areas, perhaps quite similar to what is going on in the Bay Area but without any influence of a major change in the transit system. Perhaps comparisons among metropolitan growth rates and development patterns would be helpful for appraisal of BART's impact. Perhaps through motivational research we can discover whether BART was an important consideration in location decisions in the Bay Area.

The more difficult question is this: Assuming that we find that BART has influenced land use, how are we to determine that the changes are beneficial? We must at least consider the possibility that BART actually may have encouraged some "flight" to the suburbs, especially by whites, and not have been the centralizing influence that is so often associated with transit as contrasted to highways. This possibility, of course, has both political and social implications of broad import.

Land Values—Increases in land values are sometimes thought to reflect an increase in community values. Is this a valid conclusion? Some rent theorists would argue that improvements in the urban transportation system generally reduce differentials in accessibilities and therefore tend to reduce aggregate land values. Suppose this were to happen; is the community as a whole worse or better off for it? In any event, the BART impact is not likely to be so great or so ubiquitous that such a result will occur. On the contrary, BART is apt to affect certain lands by increasing their accessibility relative to other lands and thereby increasing their site values, but at the same time

bidding for locations beyond BART's sphere of influence will be reduced and their values lessened. The gains may be readily apparent and dramatic; the losses will be virtually untraceable for they fall into the category of "what might have been."

In the appraisal of total gains and costs, the geographical frame of reference becomes important. Suppose that major changes in land use and land values take place at Fremont and Concord at the end of BART lines in southern Alameda and eastern Contra Costa. These may be regarded as salutary within the area served by BART, but have such developments been attracted from, and at the expense of, developments elsewhere, perhaps in the 6 counties of the Bay Area not served by BART? We might also raise the possibility of a law of diminishing impact. Suppose that BART's original 5-county system had been built. Is it reasonable to surmise that BART's impact in the Fremont and Concord areas would have been less because its influence would have been diluted and more widely dispersed?

Environmental Conditions—Rearrangements of land use would, of course, be one of the major environmental impacts that BART could bring about—especially if it resulted in more intensive (higher density) use of the land and thus tended to release urban land for other purposes. More directly to the point would be the extent to which BART might divert existing traffic from highways in the short run and through new land use patterns tend to cut automobile travel in the long run. The great hope of environmentalists is that a reduction of automobile travel (or a slowing of the growth rate) will lessen the need for highway and parking facilities, thus easing pressures for intrusion of transport facilities into the Bay Area and reducing utilization of scarce urban land for transport service. A second hope is that diversion of travel from highway to transit might significantly reduce air pollution from internal combustion engines, as a result of both less automobile travel and less congestion for vehicles that continue to use highways. The issue rests on the transit system's ability to lure people from their automobiles. The question remains as to how effective transit can be in the fight against smog, as compared with more direct alternatives.

It has been said that ecology has become the "motherhood issue of politics." We are also told: "The emphasis will be on resource management from an ecological standpoint rather than an economic standpoint." And it has been noted, "Therein lies the drama of Detroit's anti-pollution battle. It is not only fighting fumes that foul the air. It is fighting time and an angry public demanding that something be done—like yesterday." These attitudes stir the emotions; they do not wash away the problems.

Social Conditions—If we want BART to improve the environment, we also want it to better social conditions. Indeed, economists are inclined to view the large public subsidies that BART and its partners will receive as the means to a substantial redistribution of income. The problem to be studied is who gains through transit subsidies and who loses through tax and toll payments. Can the net effects be determined? Do some individuals pay much and gain little? Do some pay little and gain much? How do the rich fare? How do the poor fare?

In the discussion of the need for urban transit, much emphasis is given to the captive riders, those who have no alternatives because they do not have automobiles or are not able to drive. Impact research should identify the captives—the poor, the young, the old, and the handicapped—and determine how effectively they are actually being served. It is not enough to show that service is available if the captives have little reason to use it. It should be remembered, too, that transit service is available now; BART may offer better rides but at a higher price.

In appraising the social impact of BART, especially in regard to the poor, we should not overlook that the poor will pay some portion of the taxes and tolls that support transit subsidies. For example, the BART financing package now includes $150 million from retail sales taxes and $792 million from property taxes (exclusive of interest charges), each of which tends to be regressive, bearing more heavily on lesser incomes than on higher. The use of highway-user taxes or tolls, either for direct support of transit or as a measure to improve transit's competitive position, also has income redistribution effects. However much automobile use is castigated today, it is worth remembering that there are real people in those vehicles, and it is they who

make the tax and toll payments. The "highway establishment" includes more than the perfidious automobile manufacturers and oil companies and misguided highway engineers; it includes a great number of people who are poor but "captive" motorists, particularly for the journey to work. It remains to be seen how many of these will be provided a viable alternative after the advent of BART operations.

A final issue to which I invite attention is the possibility of consciously manipulating the impacts of BART through public policies. Perhaps we need to know not merely what the impacts of BART will be but what we want them to be. This clearly requires some level of consensus on regional goals and a means whereby possible consequences of alternative courses of action may be evaluated in light of these goals.

On the one hand, it seems apparent from an economic standpoint, and perhaps by any other standards, that the carrying capacity of BART and its partners should be fully exploited through effective marketing of services. There is no reason why public persuasion should not be used to stimulate location of public and private sales and service facilities, employment opportunities, and training centers that will encourage use of transit. On the other hand, a broad conception of urban welfare cannot be based on the simplistic notion that whatever is good for BART is good for the total community. The question is not what the community should do for BART, but what BART should do for the community.

If the broad view is to prevail, it appears that a regional decision-making structure of some sort will be required in the public interest to resolve conflicts and weigh equities and values within and between urban transport modes. A number of specifics have already been identified: optimization of A. C.-BART operations; the need for rapid transit extensions within San Francisco as possibly opposed to extensions elsewhere; delay or completion of the southern trans-Bay crossing. In each case more than one agency is involved, and no matter how well-intentioned their efforts, they are likely to be somewhat self-serving.

A CONCLUDING NOTE ON IMPACT RESEARCH

I have wandered rather far afield in discussing impact research and have raised issues that need to be thought through even if they cannot be researched. If the tone has been somewhat negative, it is because I have some concern that difficulties of meaningful impact research will be underestimated and that dangers of incomplete or disjointed studies may be considerable. Some of us who have participated in or observed highway impact studies over the years have not been pleased with the results and foresee similar pitfalls in studies of transit impacts. The fault will not be BART's if it does not revolutionize urban living patterns. On the contrary, it will be unfair to BART if disenchantment sets in because impossible expectations regarding changes in life quality and life styles were aroused. Let us look at BART not as a miracle worker but as a potentially valuable addition to an enormous complex of urban transport facilities.

The purpose of impact research should be to deal with all consequences and their incidences, to establish that which can be established factually and through thoughtful analysis, and constantly to question unverified assumptions and assertions. Its most useful products might be reduction of the polarization that is currently taking place in urban transportation and restoration of "balance," not so much with regard to facilities themselves but within the people wrestling with the problem.