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16. Abstract

This report describes the key decisions in the planning and implementation of Bay Area Rapid Transit (BART) during the period 1947 through 1974. The decisions are evaluated in terms of the influences brought to bear upon the decision-making process to determine decision outcomes.

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The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U. S. Department of Transportation, the U. S. Department of Housing and Urban Development, the National Science Foundation, and the California Department of Transportation. Management of the Federally-funded portion of the program is vested in the U. S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. The benefits of BART, and their distribution, will be weighed against the negative impacts and costs of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of this metropolitan area and all of its people.

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A HISTORY OF THE KEY DECISIONS IN THE DEVELOPMENT OF BAY AREA RAPID TRANSIT

September, 1975

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION

And

U. S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

A HISTORY OF THE KEY DECISIONS IN THE DEVELOPMENT OF BAY AREA RAPID TRANSIT

BART IMPACT PROGRAM

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I. INTRODUCTION

In September of 1974, the Bay Area Rapid Transit (BART) system instituted revenue service through a sub-acqueous tube beneath San Francisco Bay. Although five years behind the originally scheduled service commencement, implementation of full service connecting East Bay communities with San Francisco was hailed by rail transit's advocates in both government and industry as a momentous achievement.

The occasion, however, was not one of unalloyed joy. Public, professional, and political opinions had long since become polarized over whether BART was a good idea at all. Proponents of fixed rail, advanced technology, rapid transit systems celebrated completion of the country's first new regional rapid transit system in over half a century. Even though the system's advanced design and employment of equipment which introduced new standards of transit technology and passenger comfort had resulted in numerous operating defects that would have to be cured, the long-awaited completion of the full system was greeted by fixed rail optimists as a prototypal solution for urban transportation problems throughout America.

Among the pessimists, full implementation of the BART system signified not so much the dawning of a new era of superconvenient, super-efficient public transportation as it did the ending of a painful period of cost overruns, operational defects, and purported mismanagement. To the general public, the major issue had become very simple: Would BART turn out to be a good transportation system? But for transportation professionals and public officeholders, BART had become an issue which suffered the vicissitudes of technical and political favor.

At last the system was running. But at what price? And what was being delivered for that price? Between presentation of the 1956 regional rapid transit plan which was to lead to BART and the commencement of transbay revenue service in 1974, the following gaps had developed between BART's initial promises and its actual performance:

-- BART originally was intended to be a totally unified, regional transportation system that would integrate the transportation requirements of people living in six[1] interdependent Bay Area counties which form a natural geographic and economic region. However, the system initially was implemented in only three of those six counties and, hence, is only half a regional system.

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[1]As originally conceived with three construction phases, the BART system would have included nine counties. However, as

-- When voters living in the three BART counties of Alameda, Contra Costa, and San Francisco were asked to approve a bond issue to pay for the system, they were told that its total capital cost would be $996 million. In fact, the present estimated capital cost is slightly in excess of $1.6 billion.

-- The system was scheduled to be fully operational in January, 1969. Transbay service in fact did not commence until 1974.

-- Performance specifications for the system established that it should be capable of transporting 30,000 people per hour past any given point. To meet the specification, BART was projected as requiring 450 cars traveling at speeds up to 80 miles per hour at 90-second headways. In fact, defects in car design and delays in delivery, serious control system defects, and Public Utility Commission actions to protect the public safety, have combined to produce a present performance level of no less than 6-minute headways. Hence, the system presently is operating at a standard which is only 25% of the performance levels specified by BART's planners in justifying selection of this particular technological system as the optimum solution for the Bay Area's developing transportation problems.

-- An important justification that was given for the system's extraordinary capital costs was the forecast that revenues would be sufficiently high and operating costs sufficiently low to enable the five county system to operate without a deficit; i.e., the system was justified on the basis that it would -- in transit parlance -- "break even at the fare box." In fact, BART presently estimates deficits over the next four fiscal years totaling almost $175 million.[1]

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planning was refined, all of the original actors foresaw the nine-county system as viable only in a dimly perceived future, if at all. Phases I and II, however, including Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara, and Marin counties, would have comprised a viable, integrated regional system had necessary political approvals been forthcoming from all counties. Phase I plans included only five counties, hence the common conception of a five county plan representing the original BART jurisdiction.

[1]This projection was developed by BARTD in its "Projection of Operating Results with Various Options Reflected," June 2, 1975.

This recitation describes unfulfilled expectations, not failures. The purpose of this decision history of BART is not to evaluate the quality of the decisions that are described herein or to critique the system itself; rather, our purpose is to identify the key political, organizational, technical, and financial decisions that were made in the development of the system and to help illuminate the processes by which those decisions were made.

Nonetheless, we think it important to acknowledge explicitly the critical context in which this report will be read by many people. BART has become a subject of intense controversy not only over such matters as large cost overruns and presently unfulfilled expectations, but also over the basic question of whether this particular type of system -- even at an optimum performance level -- is most responsive to transportation needs in a metropolitan region such as the San Francisco Bay Area.

The purpose of this report serves neither advocates nor vindicators. At this point, the only kind of vindication that most people are interested in is whether or not the system ultimately will fulfill its exciting conceptual promise when the technical problems that have plagued it finally are resolved. That opportunity still lies ahead for BART. Even BART's most extreme critics, if they are professionally responsible, must acknowledge that a new technology system of this complexity requires a substantial period of time to resolve technical difficulties and hence to achieve optimum performance. Some critics have argued that the plethora of difficulties that have plagued BART is a result of an overdesigned, overly complex system which unsuccessfully attempts to apply exotic technologies that were not needed in the first place. If that is true, such decisions obviously are a matter of history. But an ultimate judgment as to whether the allegation has merit cannot be determined until a reasonable "shakedown" period has elapsed after commencement of operation. If the system ultimately does not achieve the level of service predicted in justification of its substantial capital cost, the critics of overdesigning will have been proved correct.

If, on the other hand, the system does succeed in patronage generation cost, and level-of-service terms, or even in fostering economic growth, the critics will have been proved wrong. There is little in this decision history that will inform that judgment because the final resolution is still in the future.

Given a fully operational system that eventually satisfies its level-of-service expectations, judgments on such questions as whether BART was "worth it" in terms of total cost, whether a fixed rail system is too inflexible and unresponsive to changing transportation demand, and whether the configuration of

the system has an undesirable effect on land use patterns, will be products of personal philosophies and perspectives regarding the role that publicly financed transportation ought to play within broader regional planning, and regarding the question of who ought to pay for it. The significance of these questions, however, relative to the question of performance versus promises, should not be underestimated.

Hopefully, this decision history will be of value to planners and decision-makers who still face decisions in their local area as to processes by which reliable technical advice can be obtained to inform basic judgments regarding technology selection and system design, and as to organizational and financial modes that might best be considered to achieve efficient implementation. If this report is helpful in that regard, it will not be because it evaluates the merits of the substantive decisions made throughout BART's history. Rather, it will be because it illuminates the process by which one organization undertook to organize, finance, and maximize relevant technical input for the design of an extraordinarily daring enterprise. From this review of BART's decision history, the reader may conclude that there are many things that BART Directors, planners, managers, and various consultants did right in the structuring and implementation of their decision-making processes. Other agencies can be assisted substantially, and with considerable time savings, by learning affirmatively from the BART experience. There may be other areas in which the reader will conclude that the decision-making process could more productively have taken other approaches, anticipated problems, and weighed considerations differently. In these areas, the agency considering transit system development can learn as much from BART's mistakes as from its successes.

II. EARLY PERCEPTIONS OF A BAY AREA TRANSPORTATION PROBLEM, ORGANIZATION OF AN EFFORT TO SOLVE IT, AND DEVELOPMENT OF A SYSTEM CONCEPT

A. The Perceived Problem

In the late 1940's and early 1950's, small groups of interested citizens, principally representatives of commercial enterprises led by executives of major San Francisco corporations, sowed the political seeds that eventually grew into a $1.6 billion mass transit system. The business community's initiative was developed in the context of already troublesome traffic congestion, the certainty of increasingly severe congestion as a consequence of continuing population growth, and land use trends in outlying areas that would extend the commuter travel time of large numbers of people living within the functional region known as the San Francisco Bay Area. Hence, the need for a regional transit system was perceived as emanating from both (a) increasing densities and, therefore, congestion in transportation corridors serving employment centers, and (b) increasing travel distances for more people as population growth forced larger proportions of Bay Area residents into outlying residential areas.

Since the turn of the century, California population had grown at a much faster rate than that of the country as a whole. The disparity between the California and the United States growth rates became even greater with the advent of World War II and has continued ever since. The heaviest concentrations of California's population growth were in the Los Angeles Metropolitan Area and the San Francisco Bay Area.

In 1940, the combined populations of the nine Bay Area counties which initially were considered as potential members of the ultimate rapid transit system were approximately 1,734,000. By 1954, the combined populations of those counties were estimated at 3,052,000.[1] In their 1956 report to the San Francisco Bay Area Rapid Transit Commission, "Regional Rapid Transit," the engineering firm of Parsons, Brinckerhoff, Hall and Macdonald (PBHM) summarized what they took to be the meaning of these population figures in regard to definition of the Bay Area's growing transportation problem:

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[1] California Department of Finance, cited in "Regional Rapid Transit," Parsons, Brinckerhoff, Hall and Macdonald, 1956.

"THE PROBLEM

"Today's age of automobiles has brought with its miracles a level of travel discomfort, cost, and hazard that is critical. In the Bay Area, home now for some three million people, traffic problems are aggravating. With the population forecasted to increase by more than fifty percent in the next fifteen years, they loom as staggering. . .

"The guiding (objective) for us has been the fundamental necessity for traffic to flow freely. We are convinced that the easy exchange of people and goods from one part of a metropolitan area to another is vital to its economic, social, and cultural welfare. The fact that in no metropolitan area does this ideal situation presently prevail does not alter our thinking. We are aware that people seem now to tolerate the enormous time and money costs of congestion and inaccessibility. We are confident, however, that before very long these costs will reach the point where they cannot be tolerated and where drastic programs for improvement will have to be undertaken. . .

". . . regional express highways, vital as they are in this automotive age, represent a tremendous public investment. In our search for the least-cost total solution to the problem of interurban transportation, let us appraise their ability to meet also the need for fast public transportation by carrying such vehicles as interurban buses. It is essential, first, to understand the degree to which the effectiveness of the bus or any other highway transit vehicle is impaired by traffic congestion. This congestion derives from the existence of our third category of travelers, those who have the option of using either their private automobiles or mass transportation.

"In conceiving any transportation system we are, of course, thinking in terms of the patronage of the reasonable man. When a reasonable man becomes tired of traffic jams and parking problems, he will certainly

consider using a mass transportation vehicle. However, if that vehicle is operating on the surface over a highway or street of inadequate capacity, he is frustrated in realizing any benefit from his reasonable decision, because the unreasonable man, adhering under the same conditions to the use of his private automobile, continues so to block the roads that the surface transit vehicle cannot make progress. This is, of course, discouraging; and the reasonable man returns to the use of his private automobile. The first onslaught of traffic congestion starts a vicious cycle, whereby the impeding of the surface transit vehicle is accompanied by a diversion of its passengers to private motor cars, which intensifies the congestion, progressively slows down mass transportation, and further discourages its patronage.

"So sensitive, then, is highway transit to traffic congestion that we conclude its success can be assured only under the paradoxical condition that the capacity of the highway be great enough that they would remain uncongested even if essentially all passengers were to use private automobiles. This is to say that bus transit on highways will not of itself eliminate the necessity for vastly increasing highway capacity."[1]

The above quotations from PBHM's report are set forth here because they summarize the perceptions not only of the engineering consultants who were retained to design a transit system but of the private citizens who, nearly a decade earlier, took the political, organizational, and financial initiatives that ultimately led to BART.

As will be seen, the overriding perception of the early citizens' groups, of the Legislature that organized BART, and of the engineers who designed it, was that the transportation problem that had to be resolved was congestion, which was perceived as causing inconvenience as early as 1954 and which was predicted to become intolerable during succeeding decades.

Automobile congestion on the arterial highways leading to major Bay Area employment centers, and congestion within those centers caused by convergence of too many automobiles into limited urban spaces, was seen as reducing the mobility of people for purposes of employment, commerce, and recreation; as a depressant on economic growth; and, in broader

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[1]Parsons, Brinckerhoff, Hall and MacDonald, "Regional Rapid Transit," 1956, page 1.

terms, as inimical to the American -- and certainly to a specifically Californian -- "lifestyle." Ease of mobility and access to the widest range of commerical, cultural, educational and recreational opportunities always had been the sine qua non of the "American way of life." "Opportunity" is equated with mobility -- geographical as well as social. The automobile had become the salient symbol of America's maximization of opportunity, both socially and in terms of physical mobility. Yet, the automobile paradoxically had become a constraint on mobility. As the Bay Area's population expanded, and as ever higher percentages of people owned cars, Bay Area highways became increasingly inefficient transportation systems. Automobiles -- the great "liberators" -- had come to impair rather than enhance the mobility of those who drove them.

Hence, the problem of "congestion" -- and the need to relieve it -- became both the principal philosophic argument and the principal technical argument used by early transit proponents to establish the need for a regional transit system.

Criticism of BART during the later years of its development goes beyond questions of escalating cost and mismanagement and focuses on the concept of the system itself. A history of the decisions which led to selection of the basic concept necessarily must analyze key decisions from the standpoint of what BART's critics (rightly or wrongly) contend was the "real" problem which led to selection of the particular system as opposed to the stated problem that was most prominently espoused publicly to achieve public acceptance. There is no question that, by 1950, traffic congestion was becoming a serious problem on the arterial highways leading into major Bay Area employment centers and within those centers themselves. And there is no question as to the validity of predictions of BART's earliest citizen proponents, as well as the predictions of BART's decision engineers, that population growth trends would generate additional congestion justifying development of a long-range regional transportation system. To our knowledge, none of BART's critics has suggested that there was not a need to consider some kind of transportation solution to relieve existing and projected congestion in the Bay Area. However, there have been persistent technical challenges to the proposition that the kind of fixed rail, linear system that was designed for BART is the most logical design for congestion relief (if congestion relief is taken to be the equivalent of mobility maximization for all Bay Area residents for all transportation purposes).

A companion to the technical challenge to the BART concept has been the question of the intent of BART's early proponents, many from the business community. Were the proponents of BART only secondarily concerned with the question of congestion relief and was the entire BART concept from the beginning a device for

determining future development patterns in the Bay Area so that they would coincide with the corporate objectives of major Bay Area economic enterprises? This question has been posed because the early enthusiasts of regional rapid transit were representative of the corporate estate. On the other hand, it was to the credit of BART's early planners that they did integrate land use planning, with its economic implications, with transportation planning.

The core of this challenge to the BART concept is that Bay Area businessmen reflecting large corporations' interests, early-on arrived at a joint decision regarding future desired development trends in the Bay Area. The critics allege that the linchpin of the plan was the assumption that San Francisco should become a centralized, high density, financial and commercial center which would be the equivalent of a West Coast Manhattan. San Francisco would serve as the American gateway to the Far East in the same fashion that New York City is the gateway to Europe. BART's opponents have claimed that such a plan required massive development of high-rise offices to serve banking, insurance, communications, and other service businesses, and -- complementing that development -- construction of a highly efficient, linear transit system to funnel workers into the new buildings from outlying, suburban bedroom communities. In short, it is said that the "perceived" problem that led to the BART design was only secondarily congestion relief, and that the primary problem which BART's creators sought to solve (but which they publicly discussed only in a secondary fashion) was the future development of San Francisco as a densely built-up financial and service industry center. With that perception of the "true" problem, the "solution" was inevitable: a transportation system designed not to respond to Bay Area land use trends that then existed, but a system that would make a future land use plan happen.

It is not the function of this decision history to speculate as to whether the present rate of high-rise development in San Francsico would have occurred in the absence of BART, whether the BART concept was indeed the inevitable result of a calculated plan to centralize Bay Area financial and commercial power in San Francisco, or whether such a regional land use pattern is a good or a bad idea. However, it is important that such a history attempt to relate documented political, organizational, and technical choices to all plausible assumptions regarding the purposes of the major actors who created BART.

BART's proponents and opponents will argue for years about what the "real" problem was that the engineers were told to solve, and about the "real" purpose of the system that was developed. But there will never be a definitive diagnosis of that "reality," because it is a reality that exists only in the subjective perceptions of the principal

actors, a complexity which even "definitive" historians acknowledge. Most activists, whatever their philosophic persuasions, believe they act in the public interest. Even if the principal objection of BART's severest critics -- i.e., that the system was designed to serve the development of San Francisco as a dense financial center -- were to be authenticated beyond dispute, that fact alone demonstrates neither malevolence, duplicity, nor stupidity. Such a philosophy of metropolitan land use planning would find support, as well as opposition, in the universities and among professional planning consultants.

The philosophic dispute over the BART concept can be conveniently characterized as a dispute between "big business" and the rest of the world. But such a characterization is grossly inaccurate. The controversy that has existed over BART and alternative type systems, particularly in regard to the impact that a choice between systems has on land use, is a fundamental one among planning professionals. Hence, as the history of BART's key political, organizational, and technical decisions is analyzed in this report, it is essential that the reader avoid drawing unwarranted inferences. As key choices are analyzed throughout BART's history -- from the early days of citizen initiative, through study commissions, legislative action, formation of the Bay Area Rapid Transit District, through financing, design, construction, and final implementation of revenue service -- the essence of the originally "perceived" problem, and the degree to which the system that evolved in fact was a consequence of that perception, hopefully will be illuminated.

What is described is a political process. The fact that much of that process occured outside of governmental agencies -- i.e., in the private sector -- makes it no less "political." A salient characteristic of the American socio-political system is the mixed public/private character of almost all major "political" decisions. BART is a classic study of that process at work -- i.e., heavy private participation in the advocacy and design of "public" programs.

B. Organizing to Solve the Problem: 1949-1962

This section describes the key organizational decisions which were made by influential private interest groups, the California State Legislature, local governmental bodies, and the BART organization itself. The period covered (except for reference to earlier activities which were forerunners to an explicit search for a mass transit system)

begins in 1949 -- the year of the first formal organizational step -- and ends in 1962, the year in which District voters approved the bond issue that financed BART. The scope of the organizational decisions includes enactment of enabling legislation for the creation of a rapid transit district, legislative authorization and financing of technical studies, organization of private groups to spearhead the promotion of BART among the voting public, and selection of technical consultants to design a system.

As will be seen, it is impossible to separate certain key political and organizational decisions from the technical decisions that resulted in selection of the particular transit concept that became the BART system. While the merits of the system design must be evaluated primarily from technical perspectives, it is important to recognize that the basic linear, fixed rail concept was virtually determined politically long before any technical consultants appeared on the scene. Finally, the composition of the early civic groups promoting development of a transportation system, the composition of the early Rapid Transit Commission, the composition of the BART Board itself, and the selection of the engineering firm that was to design the system were all decisions that pointed relentlessly down a single path: linear, fixed rail rapid transit.

1. The 1949 San Francisco Bay Area Metropolitan Rapid Transit District Act

In 1949, the California Legislature enacted the first legislation authorizing formation of a regional district to provide rapid transit facilities.[1] The Act defined the geographical scope of the district as including the City and County of San Francisco and the cities of Alameda, Albany, Berkeley, Emeryville, Hayward, Oakland, Piedmont, and San Leandro and, in addition, permitted the inclusion of all or any portion of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, San Mateo, and Santa Clara counties and other cities located in those counties.

While the legislation enabled the formation of such a district, its actual formation depended upon the approval of the Board of Supervisors of each county and approval of the voters. The ultimate territorial extent of the district would be based on the areas in which favorable votes were achieved.

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[1] California Statutes, 1949, Chapter 1239.

Although none of the necessary local government actions was taken pursuant to the 1949 Act, the legislation was a highly significant governmental decision for the following reasons:

-- It demonstrated the ability of a small group of interested and influential private citizens to obtain, with relatively little fanfare, a political commitment at the state level to study a potential regional transportation system which, if implemented, would have an immense impact on the future development of the Bay Area and which would incur enormous costs.

-- Most importantly, the legislation represents more than merely a governmental decision to support a transportation system; its language virtually mandated the basic concept within which the system would have to be designed.

The characteristic of the legislative decision was of the utmost importance. The title of the Act included the following language: "An Act to Provide for the Incorporation and Government of the San Francisco Bay Area Metropolitan Rapid Transit District" (emphasis added). Section III(b) of the Act defined rapid transit as follows: "'Rapid transit' means transportation of passengers by means of rail, monorail or by similar means; upon, above, or below the surface of land or water and which is, for the most part, grade separated from intersecting traffic."

Hence, the California Legislature not only authorized the creation of a transportation district; it mandated that any transportation system developed by such a district would be a linear, fixed rail system. In the normal course of events, a special purpose district formed for the purpose of providing a specific public service would not be limited simply to final engineering and implementation of a predetermined type of facility; it would have the responsibility through extensive feasibility studies to determine what kind of facility should be constructed. In this case, the legislation would have precluded any district formed under it from addressing that threshold question. The Legislature made a major technical decision obviating serious consideration of alternatives in the absence of any detailed transportation engineering, cost/benefit, or financial analyses specifically related to determination of the most efficient and cost effective way to meet carefully articulated transportation objectives in the area to be served. It is important to understand how this legislative perspective developed. That understanding requires a brief summary of events which were forerunners of the 1949 legislation.

Since completion of the San Francisco-Oakland Bay Bridge, there apparently was little interest in any quarter -- governmental or private -- in development of additional regional, interurban transportation facilities until midway through the Second World War. However, in 1943, the military became involved with transportation in the Bay Area because the poor quality of transportation hampered the war effort. In 1941, a Joint Army-Navy Board had been appointed to investigate the need and feasibility, from a national defense viewpoint, of a bridge between Hunters Point and Bay Farm Island. The Board concluded that there was no defense need for such a bridge and recommended against its construction. The Joint Army-Navy Board was reactivated to study the problem of congestion that had become critical by 1943. According to Gordon Lewin:

> "The situation was so critical that in 1943 a subcommittee of the House Naval Affairs Committee recommended a freeze in all defense contracts in the Bay Area because factories producing war materials were unable to make deadlines. It was claimed that poorly integrated transportation made journeys to work difficult which hampered the production of war materials."[1]

The Joint Army-Navy Board's studies continued for three years. In 1946, the Board held extensive public hearings, considering twenty plans, all of which revolved around some kind of additional Bay crossing. In January of 1947, the Board issued its report concluding that:

-- A fixed rail rapid transit system utilizing a centrally located tube for crossing the Bay should be a component of a comprehensive, long-range plan to solve the transbay transportation problem.

-- The transbay problem cannot be solved by indefinitely continuing to add crossings for vehicular traffic. The Board recommended that the long-range solution (i.e., rapid transit) should be considered rather than the short-range solution (i.e., an additional bridge for automobile traffic).[2]

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[1]Gordon Lewin, "Rapid Transit and the Public Interest," Stanford Workshops on Political and Social Issues (SWOPSI), 1974.

[2]Report of the Joint Army-Navy Board, 1947, p. 64.

The Joint Army-Navy Board considered a vast range of alternatives; but, in general, the various proposals were simply engineering alternatives addressing the problem of how best to achieve additional Bay crossings. Different plans, and combinations of plans, provided for either increased carrying capacity for automobiles across the Bay or for transit crossings, or for combinations of the two. But it appears that there was a virtually universal assumption that, if a transit crossing was to be built, it would be to accommodate a fixed rail mode.

Thus the Joint Army-Navy Board's report consisted principally of an engineering solution to accommodate an assumed type of transit mode, the desirability of which had not been determined by any kind of in-depth transportation study to generate reliable origin and destination data, patronage generation capability, cost/benefit analysis, financial feasibility analysis (from a total transportation cost perspective as distinct from a strictly hardware perspective), or land use impact analysis. Nor were any such studies conducted to test the desirability of a regionally-scaled fixed rail system against other alternatives between the conclusion of the Joint Army-Navy Board study and the adoption of the 1949 San Francisco Bay Area Rapid Transit District Act.

Neither were there any major governmental activities, at either the state or the local level, between 1947 and 1949, to generate momentum for development of a regional transit system. Hence, it appears that the California Legislature, and the proponents of the 1949 Act, picked up where the Army-Navy Board left off and accepted without question the only governmentally anointed recommendation that had ever been produced in the Bay Area -- i.e., a linear, fixed rail system.

2. The 1949 Bay Area Rapid Transit Committee

Under the leadership of Marvin E. Lewis, a San Francisco Supervisor and attorney, an ad hoc San Francisco Rapid Transit Committee was formed. This committee included members of the Board of Supervisors of the City and County of San Francisco and members of the business community. The questions it was intended to address included congestion and the implications of a new Bay crossing, the same concerns as the Joint Army-Navy Board. While the committee was limited to San Francisco in original orientation, it became apparent to the committee that the transportation needs of San Francisco must be addressed on a regional basis. Once the regional nature of the need was defined, representatives from Alameda, Contra Costa, Marin, San Mateo, and Santa Clara were asked to participate. At this point, the committee became the Bay Area Rapid Transit Committee.

Representatives from each of the six counties included supervisors and members of the business community. The presence of the business community has frequently led to theories that such businessmen's organizations as the Bay Area Council (BAC) were instrumental in the development of BART. The universal opinion among BART Commissioners is that the Bay Area Council had very little impact on BART's early planning. Committee members and Commissioners frequently were businessmen who were committed to the concept of regional transportation improvements and were willing and able to dedicate efforts to these early planning and organization endeavors. They were also frequently involved in Chamber of Commerce activites, and some were involved in the Bay Area Council -- a group of the region's most influential businessmen and political figures united to encourage the development of an integrated, interrelated economic region in the Bay Area. The Council's only active role, however, was confined to advocating approval of the bond issue in 1962. Prior to that time, BAC was not involved officially. Still, members of the Committee included many who held ideas similar to those of the Bay Area Council's corporate members. The Bay Area Rapid Transit Committee members and later the BARTD Commissioners, however, while professionally associated with the established corporate community, were questioned within the business community for offering an idea which was ahead of its time and which resulted in increased taxation.[1]

Former members of the Committee deny that the increase in focus from San Francisco transit problems to a regional solution was explicity considered as a survival technique for San Francisco's business, which needed access to employees and markets. Nonetheless, while San Francisco's survival was not treated as a sole justification for rapid transit, Arthur J. Dolan, Jr., an early member of the Committee, stated, "San Francisco was going to become a financial center. But San Francisco must be viewed as an island, surrounded on three sides by water. And the workers would have to live elsewhere."[2] Specifically deliberated or not, the Committee's concern toward this issue is evident. San Francisco was represented with 15 members while the other five counties were represented with a total of two members per county; the San Francisco community's concern was well represented in this forum which influenced the nature of a transportation solution in the Bay Area.

Marvin Lewis represents an example of a member of the group which was to advocate regional transit so effectively. He played a key role during the period 1949 through 1954 in the promotion of what was to become BART. Lewis spearheaded the original committee and drafted the legislation which created BART. He also served on the

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[1] McDonald & Smart, Inc., interview with Arthur J. Dolan, Jr., former member, Bay Area Rapid Transit Committee, former Commissioner, Bay Area Rapid Transit Commission, and former Director, Bay Area Rapid Transit District.

[2] Ibid.

study commission which led to the specific BART recommendations. Indeed, Lewis has been referred to as the "father of BART." However, his interest in rapid transit, even today, is highly individualistic: he believes the only answer is a monorail system for the Bay Area. Lewis' personal interest in monorail is a single example of the type of individualistic motives represented among the members of the Committee, and later the Commission. While each was to contribute to the momentum of finding a regional rapid rail solution to transportation problems, the individual incentives among the germinal group of advocates were diverse, not unified.

Despite this, the early and continuing role played by businessmen and business leaders in planning a regional transportation system repeatedly has been seized upon by BART's critics as evidence that the system which ultimately emerged was not really a technical response to the total transportation needs of Bay Area residents in their naturally developing land use patterns, but rather was a necessary tool in a big business plan to Manhattanize San Francisco. Much has been written to try to demonstrate that the key decisions relating to the organization, system choice, and route locations of BART were all inevitable outgrowths of such initial business oriented plans.

Articulations of this thesis range from Stephen Zwerling's Ph.D. dissertation -- "The Polical Consequences of Technological Choice: Public Transit in the San Francisco Metropolitan Area" -- to Burton Wolfe's series of articles in the San Francisco Guardian. There is little question that Zwerling, Wolfe, and others have identified the Bay Area Council as the principal locus of influence which shaped the nature of BART's development. Some would also say that members of the Blythe-Zellerbach Committee, a funded group of leading businessmen who study problems of San Francisco, were equally involved in the impetus for BART. Actually, the individuals involved in directing early BART planning were members of corporations represented in these arenas. An active role by the leaders represented in these two civic affairs groups did not occur until the bond issues elections in 1962, by which time the corporations involved had recognized that the economic advantages to the region from a regional transportation system would prove more beneficial than the negative impact of the increased taxation for the bond issue.

BART's critics, however, have often concluded that selection of the particular system was a direct consequence of a "Manhattanization" plot; that business interests ultimately controlled selection of the system; that sufficient professional planning and engineering support would not have been marshalled in any event for such a system had it been sought earlier in the planning process; and that such a system -- even if it were proved to serve the interests of a business master plan -- would thus by definition be inimical to the broader transportation interests of Bay Area residents. Although the Committee members' concepts

of transportation for the Bay Area were developed from largely an economic development perspective, that does not mean that, had the nation's top five transportation analysts -- rather than representatives of the Bay Area's top five corporations -- been sequestered in a room and told to come up with a transportation plan for the Bay Area, they would not in 1949 come up with an interurban, linear, fixed rail system.

What now appears to have been a virtually tacit assumption of all of the most interested parties -- i.e., the Army/Navy Board, eventually the Bay Area Council and its constitutent members, and the California Legislature -- must be analyzed in historical perspective; here we try to establish that context in which to judge historical events.

In 1949, public acceptance of bus transit as a viable or desirable alternative to the auto was waning all over the country. In the succeeding two decades, bus transit ridership had declined dramatically in absolute terms and scores of systems had gone out of business despite rising urban populations. Buses had developed an image of being dirty, uncomfortable, obsolete vehicles fit only to serve either those who couldn't afford automobiles or rural school children.

Any metropolitan region in search of a high impact transit technology in those years would have been hard put to justify -- either in terms of what was then known technically or in terms of public salability -- a regional, interurban bus transit system of sufficient magnitude to eliminate congestion and divert travelers from automobile use to transit use. The notion of exclusive bus lanes running throughout a metropolitan region's transportation corridor was then but a gleam in the eye of the most prescient transportation planners.

The current popular search for the flexible, "low capital intensive" system -- with its paradoxical preference for buses and preserved sections of highway pavement as components of an advanced, "creative" solution -- had not yet developed. Planners are as seduced by fashion as anyone else. The return of the "simple solution" -- i.e., buses (made modern and comfortable) and traveling on their own rights-of-way -- became fashionable in response to two factors: (a) a growing awareness that the capital expense of fixed rail systems throughout America would be much greater than the resources that likely would be politically available to pay for them (an awareness, incidentally, that grew largely out of the BART experience), and (b) a shift in socio-political philosophy from enchantment with big government and "big" urban program solutions to an "urban populism" characterized by "neighborhoodism," decentralized de facto political structures in the cities, and popularly forced shifts in the emphasis of government programs from things like massive urban renewal to neighborhood rehabilitation.

In an incredibly short period of time, urban programs which had the character of macro-solutions fell into disrepute. Urban activists demanded more discretely designed programs that were sensitive to district and neighborhood needs, and increasingly demanded that the design of such programs come from governmental units directly associated with the communities being served rather than from super governments or from vaguely perceived "establishments" imposing "massive solutions."

The return to fashion of buses as providing "flexible and demand responsive transit" is a direct philosophic corollary to the recently developed emphasis of urban activists for "demand responsive" urban renewal and social programs. The critics' perception of transportation issues, as well as virtually all urban issues, is that the programs should not be designed to serve abstract economic "systems," but should be designed to serve people and to serve them where they live.

None of this analysis answers -- nor is it intended to answer -- the arguments that (a) a linear rail system, without adequate feeder service, tends primarily to serve core city communities and not total all-purpose transportation requirements or (b) that such a system, because of its inflexibility, makes transportation a determinant of a development future rather than a flexible public utility serving a future determined by broader-based land use preferences. However, this analysis is intended as an attempt to recreate the intellectual decision-making climate that existed from the mid-1940's to the mid-1950's when key decisions were made, and to emphasize that fundamental choices made in those years were constrained by the perceptions regarding viable alternatives that existed.

Yet, much of the harshest criticism, particularly in the area of motives, that has been leveled at BART's early planners assumes a current state of creative thinking about social, philosophic, and transit alternatives which only have emerged into prominence since those early decisions were made. Most specifically, the renaissance in the credibility of the bus, as supplemented by the increasing financial and political feasibility of exclusive bus lanes, had not yet occurred when BART's irreversible design commitments were made. The ex post facto nature of the insights underlying criticism of the BART concept is most clearly demonstrated by the resounding silence of professional planners during the early days of BART's design effort. Despite extensive publicity, the public record is largely bereft of serious opposition among professionals. We have been unable to identify signficant numbers of prestigious professionals who questioned the BART concept.

BART's critics continue to focus on purported business community cabals as the object of their criticism even more than they do upon academic and objective technical criticisms of whether the system is capable of meeting its stated objectives. Many critics have been unduly preoccupied with who made the basic system choice, failing to recognize the likelihood that -- in the context of what was known among professional planners and in the context of then-perceived social values -- many transportation as well as land use planning professionals might well have made the same decisions. Failure to recognize that fact has resulted in BART's critiques often taking on the character of a theory in pursuit of facts to support it. A good example is Stephen Zwerling's comment on the relationship between the Joint Army-Navy Board recommendations and the private influence groups in San Francisco. In his dissertation, Zwerling makes the following observation:

> "Although it demurred on the immediate requirement for new facilities, the Board did recommend a completely integrated rapid transit system with a sub-aqueous tube between San Francisco and Oakland. While the implications of that study were not immediately obvious, the context of the discussion on rapid transit had undergone a shift of major importance. What had previously been a local concern articulated by local elites had become a regional concern supported by national authorities."[1] (Emphasis added)

Taken in the context of his overall thesis, the inference that the author intends to be drawn from the underscored sentence is obvious: "local elites" (read: San Francisco financial interests) had long been agitating for an interurban fixed rail system connecting San Francisco with outlying areas in the region. Because congestion had mounted rapidly during the War impairing the free flow of traffic, residents of the region outside of San Francisco also became concerned. Because of the national defense interest, the issue became a national one and the result was federal endorsement of a fixed rail system with a sub-aqueous tube to support the long-standing plan of the "local elites" for the centralization of finance and commerce in San Francisco.

Zwerling supplies no documentation whatever for the proposition that "local elite" agitation for a fixed rail interurban system preceded the Federal study, and we have found no evidence that would support such a proposition. As noted above, the first major effort to organize the business community behind a mass transit plan occurred in 1949, some two years after the Army-Navy study report, and six years after the initiation of the study.

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[1] "The Political Consequences of Technological Choice: Public Transit in the San Francisco Metropolitan Area," Stephen Zwerling, November 1972, page 31.

This is not to argue with the assertion that San Francisco civic leaders eventually envisioned a "decline in the city's status as the cultural and economic capital of the West . . ." as a result of development of low density suburbs and the movement of some retail businesses and light industry out of the city. Nor does our analysis of this early decision history necessarily conflict with the view of Burton Wolfe and others that the civic leaders envisioned not only salvaging San Francisco from a decline but, rather, saw a mass transit system as an essential ingredient to the creation of San Francisco as America's financial and commercial gateway to the Far East.

However, what we do argue is that the historical record does not demonstrate that San Francisco's business leadership unilaterally, and without technical support, foisted a particular transit system technology and configuration upon residents of the Bay Area. To the contrary, the Joint Army-Navy Board had, years before the business community had organized to promote mass transit, recommended the same solution on transportation grounds alone. And we have discovered no evidence whatever that the Federal recommendations were in any sense the product of the advocacy of a previously active "local elite."

Alan K. Browne, an active advocate of mass transit in the Bay Area as early as his involvement in the San Francisco Chamber of Commerce's Parking and Transit Subcommittee in 1948, actually cites the difficulties in motivating the business leadership to even respond to the concept of transit. Until the late 1950's, his efforts as a BART Commissioner and later as President of the Chamber of Commerce were ineffectual in stirring business leadership response. Concern over higher taxes and resistance by the automobile and oil industries encouraged a general attitude of passive response. By 1969, however, the interest in BART within the corporate sector had increased: the banks, which had originally been hesistant to support an idea that might offend large corporate clients, recognized their larger market potential which would result from a wider geographic employment base linked to central cities by transit; the utilities recognized a major new client in rapid transit, and labor recognized the impact rapid transit construction would have on employment in the Bay Area. To some manufacturing interests, new interest reflected the recognition of BART's ability to direct future land use, hence to facilitate future industrial and commercial planning. The business community's general support was reluctant; even the Bay Area Council maintained an attitude of expanding bridge capacity first. Still, as the planning progressed, and the BART system appeared a feasible transportation alternative, the business community began to rally to its support.[1]

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[1]Interview with Alan K. Browne, former Commissioner, Bay Area Rapid Transit Commission, former President of San Francisco Chamber of Commerce, and former officer of Bank of America.

3. The 1951 San Francisco Bay Area Rapid Transit Commission

Despite the considerable enthusiasm for rapid transit among Bay Area civic leaders, none of the local jurisdictions described in the 1949 enabling legislation as potential members of the future transit district took the required actions to form such a district. The plethora of local jurisdictions involved, combined with the absence of the kind of systematic public information effort required for public support of such an undertaking, prevented District formation. Local politicians would not allow exposing the tax base of their jurisdictions to an undefined concept. Moreover, none of the in-depth technical studies which would be essential to present a plausible plan to the public had been undertaken.

Recognizing that the 1949 enabling legislation would not, in and of itself, lead to the formation and financing of a rapid transit district, the system's proponents were active, in 1950 and 1951, to build the necessary support for further legislative action. In 1950 and 1951, the State Senate Interim Committee on Rapid Transit, under the aegis of Senator John McCarthy of Marin -- a friend of several members of the Bay Area Rapid Transit Committee -- held a series of hearings to determine what further "legislative action is necessary in the way of surveys, technical and engineering studies, etc. to speed action on the problem."

The Senate Committee also sought information to determine "progress that had been made by the committee formed in the nine surrounding Bay counties by Marvin Lewis in 1949."[1]

At one such hearing, major speakers included Lawrence Livingston, Assistant Planning Engineer for Oakland, and Lewis, who at that time was a San Francisco Supervisor. Lewis's testimony was particularly significant in its early recognition of the critical role of a sophisticated public information effort if rapid transit were to become a reality:

> "The task of educating people to such a need is a long and arduous one. Finances must be secured for this purpose alone."

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[1] Hearings of the Senate Interim Committee on San Francisco Bay Area Metropolitan Rapid Transit Problems, 1951.

Senator O'Gara, the Committee's chairman, said he believed it doubtful that money to "educate the people" could be appropriated from the State. However, he mentioned the possibility of assigning State engineers for an early survey into the proposed system.[1]

Livingston seconded Lewis's statement that appropriations for education and study were needed but added, "There is an acute consciousness on the East Bay side as to the need for a rapid transit line." The statement contradicts the assertion made by some of BART's opponents that the earliest legislative actions leading to formation of a rapid transit district were the product solely of San Francisco civic leaders' preoccupation. The City of Oakland officially supported the system as early as 1950, and thirty-six cities and nine counties were represented on the Lewis committee.[2]

The hearings of the Senate Interim Committee led to the Legislature's amendment of the 1949 Act in 1951. The amendment created a San Francisco Bay Area Rapid Transit Commission and appropriated $50,000 for the Commission to "study and investigate the rapid transit problems in the San Francisco Bay Area." The Act required that the Commission report "the results of its investigation and study and its conclusions and recommendations."

Key language in the mandate given the Commission required it to "aid governmental bodies in the various cities and counties in the area in . . . furnishing engineering, planning, and other technical assistance where not available; in correlating the findings and, with the aid of qualified engineers, fiscal experts, and local representatives, in developing a master, coordinated, rapid transit plan. . . ."

The "rapid transit" language cited above is important. Although engineering consultants hired subsequently by the Commission were aksed to study all possible alternatives, including highway, bus, and various fixed guideway technological solutions, the mandate expressed the direction in which the recommendations were expected.

Further, the 1951 legislation was not a new Act; rather, it was an amendment of the 1949 legislation, and was subject to all of the definitional language of that prior legislation. The 1949 Act defined "rapid transit" as "transportation of passengers by

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[1] Ibid.

[2] This East Bay support in 1951 was simply a reaffirmation of the position of East Bay communities as early as the public hearings conducted by the Joint Army-Navy Board in 1945 and 1946. While San Francisco officials were more vocal in support of the eventual Army-Navy "solution," the record is devoid of significant East Bay opposition to the plan.

means of rail, monorail, or by similar means." The Commission was the creature of the 1949 Act as well as the 1951 amendment and clearly was subject to the Legislature's conception of mass transit.

The 1951 legislation creating the Commission was a key decision in the history of BART in that it:

-- Perpetuated the basic legislative criterion that a regional transportation system would be a rail system; and

-- Made the first state financial commitment to the funding of technical studies that would be necessary to proceed with system planning and obtain public support for financing.

It is worth noting that the legislation creating the Commission was drafted by Marvin Lewis, but -- more importantly in the context of his long-range role -- the organizer of the original Bay Area Rapid Transit Committee.

An important political difference existed between the Commission and its predecessor, the Committee, however. Half of the Commission's 25 voting members were appointed by the Governor, hence independent of the concepts of BART as they had evolved in the Committee's deliberations.

The real leadership of the Commission shifted to the Governor's appointees. Although Marvin Lewis was the second Chairman elected by the Commissioners and deserves the credit for gaining the financial support from the Legislature which made possible the Commission's studies, the Chairman during most of the active planning years of the Commission was Harry Mitchell, a retired Vice President of Western Pacific Railroad appointed by the Governor. Alan K. Browne, also a gubernatorial appointee, became Chairman of the Commission during the critical time of forming the BART District (1957). Browne, however, had previously been a member of Marvin Lewis's committee.

4. The 1953 San Francisco Bay Area Rapid Transit Commission Preliminary Report to the Legislature

The 1951 amendment described the full mandate of the San Francisco Bay Area Rapid Transit Commission as follows:

> "The Commission shall study and investigate the rapid transit problems in the San Francisco Bay Area. It shall aid governmental bodies in the various cities and counties in the area in investigating their interurban and local transit needs, present and future, and in combining their findings and proposals with other

> cities and counties in the area; in furnishing engineering, planning, and other technical assistance where not available; in correlating the findings and, with the aid of qualified engineers, fiscal experts, and local representatives, in developing a master, coordinated rapid transit plan, including an estimate of the cost of construction and of necessary lands, equipment, and facilities."[1]

The Commission hired the engineering firm of DeLeuw, Cather & Company for the first technical study, under Commission auspices, of a future Bay Area transit system.

DeLeuw, Cather submitted its report to the Commission on December 8, 1952. Since the report provided the overall technical justification essential for maintenance of the political momentum and ultimate public acceptability of a regional transit system, the report merits considerable attention.

The engineers' recommendations to the Commission were as follows:

1. Prepare a long range regional development plan.
2. Undertake origin and destination studies of interurban passengers.
3. Study the general economic and physical factors of private and mass transportation.
4. Prepare an overall regional transit plan.
5. Prepare preliminary plans and make a financial analysis of the first stage of construction.

The consultants estimated that the cost of these activities would be $750,000. The first three studies were estimated to take approximately 18 months at a cost of $400,000. The last two, which were to require an additional 18 months, were estimated to cost $350,000.

It is worth taking special note of some of DeLeuw, Cather's comments regarding the need for preparation of a "long range regional development plan":

> "Prior to the time that routes of rapid transit throughout the area may be determined a regional plan relating the development of each county to the other counties is essential. The characteristics of the various portions of the Area must be studied, and determination made as to what sections may logically be expected to be used for industrial, commercial, residential, or recreation

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[1]California Statutes, 1951, Chapter 1760, Section 39(d).

purposes, based upon their economic potentalities and geographic features. Estimates must also be made of the distribution of the future working and living populations within the area.

"Only after such studies have been made may reasonable appraisals be made of the desires of people to travel about in connection with their daily activities. A plan of development resulting from such studies need not be considered as an ultimate one, but it must be sufficiently valid to permit the determination of the probable scope of mass transportation requirements."

It is clear that -- at the outset of the BART planning process -- DeLeuw, Cather clearly recognized the functional and sequential relationship between land use and transportation planning. There was, however, a problem. Note the last paragraph of DeLeuw, Cather's comments regarding the need for land use planning:

"The preparation of such a regional development plan may be considered outside the scope of the Commission's activity, but inasmuch as no authentic information of this nature is now available, the Commission is faced with the necessity of preparing such as plan for its own use."

At the time that BART was conceived, planned, and designed, there was no regional land use plan. Most of the counties did not have adequate land use plans. Hence, there was not even a basis for an effort to develop a regional plan based on the sum total of the various counties' plans. As a result, the Commission followed the consultants' recommendations, and in fact, produced a Bay Area regional plan. In essence, the situation can be summarized as follows:

-- The Commission's engineering consultants, and the Commission itself, perceived the functional relationship between land use planning and transportation planning.

-- However, a regional general plan did not exist, and there was no governmental agency engaged at the time in the production of such a plan. Moreover, the planning of the involved Bay Area counties was insufficient to provide a basis for producing a derivative regional plan.

-- Since there was no Bay Area land use plan, and since one was needed in order to plan a rational transportation system, the San Francisco Bay Area Rapid Transit Commission proceeded to produc one "for its own use."

-- Hence, a single purpose commission -- whose sole official responsibility was transportation planning -- by default of other governmental processes, and as a necessary part of its own activities, produced the first general plan for the San Francisco Bay Area.

-- Based on that general plan, the same commission proceeded to design a transportation system which, in the opinions of the planners, would be most likely to make the general plan "happen" -- i.e., a transportation system with a geographical configuration and technology that would tend to promote actual development trends consistent with the Commission's general plan.

-- The transportation planning agency (i.e., the Commission) which undertook this regional land use planning responsibility operated from the outset under a legislative mandate to study and plan for a fixed rail system.

The record is clear that accusations that BART gave inadequate consideration to land use impacts are unwarranted. To the contrary, BART's planners gave thorough and highly professional consideration to the system's likely impacts upon land use.

Based on the DeLeuw, Cather report, the Commission recommended to the California Legislature the following actions:

> "(1) That there be made available to the Commission the funds required to develop for the nine counties of the San Francisco Bay Area a Master, coordinated rapid transit plan, and for carrying out the studies and surveys essential to the development of that plan."
>
> "(2) That the required funds be made available through an appropriation of $400,000 by the State of California, and by the appropriation of a total of $350,000 by the nine counties of the San Francisco Bay Area."

a. Selection of Consultant for Major Study

In response to the Commission's 1953 recommendations, a subcommittee of the Commission was established to find a qualified consulting engineering firm for a regional transit study. The 1953 Legislature responded to the Commission's report and its request for funds by granting a loan of $400,000 from state monies contingent upon $350,000 to be appropriated by the Bay Area's nine counties.

In August, 1953, the Commission announced its selection of the New York engineering firm of Parsons, Brinckerhoff, Hall and MacDonald (PBHM), from among four firms which submitted proposals. The selection was not without its critics. The San Francisco News, on August 7, 1953, said, "The firm has never done traffic or bridge studies in this region and so has no past reports to defend." PBHM did have to its credit credentials in tunnel engineering and the engineering experience of portions of the New York Subway system, early in the century. Members of the Commission commented that PBHM was clearly the "the most experienced and imaginative." John C. Beckett, Chairman of the Commission's Engineering (hence, Selection) Committee, recalls, however, that it was the presence of Adams, Howard and Creeley, a Boston planning firm, on the team that swung the selection to PBHM. Among the unsuccessful competitors was the firm which prepared the preliminary report for the Commission leading to this larger study.

The News also quoted the Chairman of the Selection Subcommittee as saying that in addition to conducting the various studies previously suggested, the consultants would "analyze the bonding capacity of the nine counties and tailor their recommendations to the financial possibilities."

In November, 1953, the Commission entered into a contract with PBHM for the study and work was begun early in 1954. The contract called for a report to be submitted in January, 1956.

PBHM submitted its engineering report on schedule to the San Francisco BART Commission. The PBHM report is the basic technical foundation for the BART system. Both PBHM and the Commission recommended a supported (as opposed to suspended) interurban rail rapid transit system to be built in three stages and to traverse the Bay in a subaqueous tube.

b. Summary of Recommendations

The PBHM summary makes it clear that the system was designed to solve the triple problems of peak period auto congestion between the urban centers and residential suburbs, declining

transit patronage, and the need for "regional express transportation." The "basic alternatives" were described as "drastic decentralization and repatterning of the Bay Area's urban centers" or "to reinvigorate interurban transit so as to sustain the daily flow of workers, shoppers, and visitors on which the vitality of these urban centers depends." Accompanying the conclusion that "interurban rapid transit must be conceived as providing only arterial or trunk line connections" was the recognition that "adequate local distribution and collection must be provided by either the private automobile or local transit services."[1]

The purpose of the study was to evaluate the problems of transportation in the Bay Area and to recommend solutions. Alternatives were reviewed, including highway capacity expansion and increased bus service. The former was rejected because it was deemed infeasible to justify economically sufficient capacity expansion to accommodate peak hour requirements and the latter was dismissed as not being able to avoid congestion.

c. Support and Opposition

It is important to note that the Commission's report was greeted with almost unalloyed enthusiasm by the public, the press, professional planners, and California legislative bodies.

A summary of Bay Area press reaction was published in the Oakland Tribune of January 11, 1956:

> "San Francisco newspapers are unanimous in their favorable editorial reaction to the rapid transit plan for the Bay Area presented last week.
>
> "To the Chronicle: 'Rapid transit is a way of salvation.'
>
> "The Call Bulletin declares: 'Transit program calls for action.'
>
> "The News notes that: 'It would mean a fabulous future for the Bay Area.'
>
> "The Examiner comments: 'This area's strong growth will continue and people must get from place to place.'"

While some opposition did manage to reach the news media, it generally was buried in the torrent of praise and support for rapid transit.

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[1] Regional Rapid Transit, page 38.

[2] For a list of BART supporters and opponents, see Appendix B, which was compiled in reference to their positions on Proposition A, BART's 1962 referendum on the bond issue.

d. Legislative Response -- Creation of the San Francisco Bay Area Rapid Transit District

Similarly, legislative response to recommendations for a linear, fixed rail system was very favorable. However, previous legislative deliberations had documented its interest in this solution. The key body in the Legislature from 1951 up through the creation of the Bay Area Rapid Transit District was the Senate Interim Committee on San Francisco Bay Area Metropolitan Rapid Transit problems. Created in 1951, it was the Interim Committee that, in its April, 1951 report to the Legislature, recommended creation of the Commission, and then in March, 1953, responded enthusiastically to the Commission's preliminary report of January, 1953, by publishing its own report, "Mass Rapid Transit," boosting the Commission's work and its continued existence.

The Committee also had held three hearings and open meetings in San Francisco on November 12, 1952, December 9, 1952, and February 28, 1953. Of the nineteen persons listed in their report as attending the hearings, a large number -- thirteen -- were members of the BART Commission, and one was Alfred J. Lundberg, the past president of the American Transit Association.

Thus, the legislative deliberations during BART's earliest formative period consisted largely of pro-fixed rail activists talking to each other. Whether this was due to general public apathy regarding the issue or due to a broadly based tacit public acceptance of the linear fixed rail concept is not clear. But what is certain is that there was not at any time a sophisticated effort by knowledgeable people to mount an anti-BART campaign. At the time the system was planned, there was an almost uncontradicted enthusiasm among a broad range of public and private opinion-makers and decision-makers for the project.

By the time of the PBHM report, a momentum already had developed which made acceptance of the report's recommendations almost inevitable. Neither during the 1951-53 preliminary study period, nor during the 1953-57 period, in PBHM's comprehensive study were technical alternatives explored with the same enthusiasm or thoroughness as the rapid transit alternative (although, of course, knowledge of the state-of-the-art of highways and bus technology was more readily available). A variety of alternative system concepts were acknowledged in the reports, but dismissed. In none of the reports of the Senate Interim Committee are feasible alternatives identified.

Reference to the remarks of Alfred J. Lundberg, illustrates the kind of largely unchallenged euphoria that energized legislators, the press, and public alike.[1]

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[1]See Appendix C.

The PBHM position was that the supported rail system was "the only method of rapid transit to which the Bay Area could make an irrevocable commitment in advance of extensive physical tests."[1] A period of research and testing was proposed to refine many details of the system, such as the choice between rubber or steel wheels and the exact design of the control system, propulsion system, fare collection system, and other components, but these were regarded as small and attainable advances in an otherwise proven system. In a section titled, "Other Possibilities: Untested," the report examined suspended trains; a system of "aerial transit" or rubber tire-supported trains proposed by Henry Norton, a transit consultant, and others; a multi-right-of-way vehicle, which today would be called a dual mode bus; and conveyor systems. Norton's system was described, the suspended train was considered further in the report but eliminated for architectural and cost reasons, and other possibilities were more critically treated as inadequate for the purposes under consideration. A supported rail system was deemed by the engineers as the only feasible system capable of meeting the program requirements with a high degree of certainty within the technological state-of-the art.

In response to the study, the California Senate passed a bill in April, 1957, forming a Bay Area Rapid Transit District (BARTD) which provided for a four-county district consisting of Alameda, Contra Costa, Marin, and San Francisco counties. The Assembly added San Mateo County, and the Senate concurred on June 4, 1957, and the approved bill was signed by the Governor on September 11, 1957. Santa Clara County, at the south end of the Bay, requested omission from the District, although it was included in the draft version of the legislation. The three other counties that formed the Commission -- Napa, Solano, and Sonoma -- were omitted because they were so far from San Francisco and so lightly populated that they were proposed for rapid transit service only at a third stage. The law permitted these counties to join the District later and also permitted member counties to withdraw if they chose to do so.

The Legislature's formation of the District followed an earlier study by Stanford Research Institute (SRI), funded by the Commission regarding the organization and financing of the Bay Area Rapid Transit System. The salient points of the SRI report recommended a regional organization with the power to issue bonds based on property taxes or other sources and a uniform power of administration throughout the District. SRI recommended that the Governing Board should not be so large as to be unwieldy and that the General Manager should have the entire administrative responsibility and accountability. The organization also

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[1] Regional Rapid Transit," a Report to the SFBARTC, Parsons, Brinckerhoff, Hall and MacDonald, January 5, 1956.

should have discretionary power to make contracts with private agencies which might engage in transit service. SRI recommended the organization be given latitude to work out its own organization as the need might arise in the development of the transit system. The report was transmitted to the Legislature on March 15, 1956.

The draft bill regarding organization of the BART District was drafted by the Commission with the help of the legislative counsel and the Attorney General's Office. The Commission's report to the Legislature identified three criteria for organizational legislation. It is evident that, while all three conditions were important, they carried with them the seeds of potential conflict:

> "1. The legislative act should provide the agency with authority commensurate with its responsibilities;
>
> "2. Adequate overriding public controls should be provided to safeguard the public interest;
>
> "3. To the extent practicable, functioning of the agency should be kept free of the restrictive procedures which result in delays and interferences that are out of proportion to the benefits that may be gained from them."

The first and last conditions were conceived out of the general mood of enthusiasm which had generated the widely held conviction that nothing should be permitted to halt the momentum toward realization of a Bay Area rapid transit system. This perspective -- articulated in the Commission 's report to the Legislature -- persisted throughout all aspects of BARTD's formulation, from the legislative act which created BART to the internal organizational modes adopted by the District after its formation. "Adequate overriding public controls . . .," on the other hand, while undoubtedly of philosophic importance to the commissioners and legislators, was given less attention in formulating organizational details than was the principle of creating an organization which was capable of expediting development of the system. This perspective toward the relative importance of expediting "action," as opposed to public checks and balances, is apparent in the powers given the general manager vis-a-vis the BART Board itself,[1] and the autonomy given the engineering consortium which completed the design, engineering and construction management.

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[1] See Section III-6.

Some of the salient features of the law were the following:

-- Vesting the government of the District in an appointed Board of Directors representing each of the counties within the District.

-- Permitting the District to issue general obligation bonds up to the amount authorized by voters at a bond election, subject to the limitation that outstanding general obligation bonded indebtedness not exceed 15% of the assessed value of the property within the District.[1]

-- Permitting the levying of a tax on property within the District to pay interest and principal on general obligation bonds until they were retired.

-- Permitting the issuance of revenue bonds and equipment trust certificates payable solely from revenues derived from operation of the system.

-- Permitting the District to levy a tax not to exceed $0.05 per $100 assessed value to raise revenue for general administration, maintenance, and operation but not to be applied to debt service on general obligation bonds.

-- Specifying that the first Board of Directors be composed of sixteen members, four each from Alameda and San Francisco counties, three each from Contra Costa and San Mateo counties, and two from Marin County. Appointments to the Board were to be made by legislative bodies of the counties and cities in the district.

The new Board of Directors held its first meeting on November 14, 1957. On December 31, 1957, the BART Commission went out of existence, its work completed.

The organizational form of BARTD can be evaluated by comparing the alternatives which were considered and dismissed. The most important of these alternatives was the one which clearly was deemed that most attractive by Stanford Research Institute in its 1956 report -- i.e., a regional transit authority.

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[1]The general counsel of BART interpreted the law to authorize bonded indebtedness not to exceed 15% of the assessed value as the bonds were issued, permitting BARTD to take full advantage of the escalation in assessed value. It should be noted that this was the highest debt/assessed value ratio ever authorized in California for a single taxing entity.

The fixed rail system could in effect have become the "linear spine" of the regional system, which would have consisted of total integration of the various bus systems operating in the area with BART. This alternative would have permitted the amalgamation of existing local and line haul transportation agencies under a single authority.

Members of the Commission, however, have reiterated that the latter possibility was never seriously considered. To their recollections, Commission proceedings were primarily concerned with the organizational structure which would provide a regional transit system, without having explicitly deliberated the potential for regional integration of local and line-haul transit. Furthermore, the A.C. Transit District was created in the East Bay in 1956. There was strong political rivalry between A.C. transit and the nascent BART District, which deterred the formation of a regional transit authority. The East Bay constituents and their appointed representatives on the Commission were strongly opposed to including local transit as a part of the BART mandate. "As a practical matter, the East Bay contingent insisted on an independent transit district which became A.C. Transit."[1]

C. Political Organization at the County Level -- The "Region" Shrinks

BART's history has been characterized by ambitious goals initially conceived in climates of both political and technical optimism, followed by a shakedown period during which realities -- sometimes painfully recognized -- increasingly displaced the planners' dreams.

In the area of technical performance, the initial creation of expectations, followed by the tempering of those expectations by recognition of what the system in fact could accomplish, has been discussed elsewhere (see Section I). That process of shrinking ambition and growing reality in the technical performance area had its parallel in the political arena.

BART originally was conceived as a comprehensive regional transportation system for the entire Bay Area. The organizational history of BART consists of a series of key political and public decisions which progressively constricted the geographical area of service, as political and economic realities combined to carve out that piece of the original vision which, as a practical matter, was attainable.

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[1]Memorandum from John Beckett to Richard J. Smart, "A History of the Key Decisions in the Development of BART," July 17, 1975.

It had become obvious during World War II and the remaining years of that decade that the already discernible industrial, commercial, and population growth trends of the San Francisco Bay Area were going to accelerate, rather than level off, in the foreseeable future. It also became clear that the area's future as an integrated region was seriously impaired by the area's natural geography which separated the two peninsulas from the East Bay. The impetus for the philosophy which eventually led to BART -- i.e., the joining of these subregional areas for the collective developmental benefit of all -- began with the construction of a series of bridges to surmount the barrier created by the San Francisco Bay. Two separate agencies were created to manage the Bay crossings, the Golden Gate Bridge and Highway District (for the Golden Gate Bridge) and the California State Toll Bridge Authority (for all other San Francisco Bay toll bridges).

The Bay bridges were constructed primarily for highway traffic, the major exception being the joint use, until 1957, of the San Francisco-Oakland Bay Bridge (the Bay Bridge) by the Key System for electric interurban rail service. For this purpose, the lower deck of the Bay Bridge was shared with highway lanes for buses and trucks. Yet, study groups had considered since 1947 the creation of a transbay tube to connect San Francisco and Oakland with improved electric rail service as part of a regionwide subway and above-grade transit system. These studies were conducted or participated in by the Army, Navy, State Toll Bridge Authority, and numerous city and county agencies.

The construction of the bridges was complemented by the construction and continual improvement of a network of freeways and primary highways. This bridge/highway network increased the mobility of Bay Area residents by orders of magnitude and quickly transformed the area into a true socioeconomic region.

In the years immediately following World War II, it became apparent from rising growth projections that the automobile could not be relied upon in the years ahead as the sole major mode of transport. There would have to be a viable transit alternative. In analyzing the potential configuration of such a transit system, planners and politicians automatically assumed that the region which was geographically contiguous to the Bay as well as economically inter-linked would be the region to be served by any new transit system. Hence, when the BART Commission was formed, it consisted of all nine Bay Area counties. While highway planning could occur on a regional basis, this assumption toward transit development failed to take account of several realities.

The nation's highway construction program was based on an assumption that highways would go through -- and, hence, serve -- rural populations as well as densely populated urban areas. But highway financing was provided mainly by federal and state sources backed up by rural constituencies able to provide the political leverage necessary to draw upon urban gas tax funds to generate non-urban benefits.

However, a transit system -- as the early planners soon would discover -- is quite another matter. On functional grounds alone, a capital-intensive transit system -- and certainly a costly fixed rail system -- cannot be justified to politicians or the public on cost-benefit terms in sparsely populated areas. Beyond that, the political leverage to finance it was nonexistent. The major portion of the fixed rail system would have to be financed by the taxpayers of the specially created district. The tax base of most of the counties which were included in the original Commission membership would be insufficient to support their segments of the system on a District-wide tax rate. Furthermore, the Commission did not feel that the urbanized counties would be willing to accept the higher tax rate necessary to support the rural counties' portion of the system. The northern counties of Sonoma, Napa and Solano were omitted from the first two phases of BARTD's regional system on functional grounds, patronage projections, those projections' financial implications, and political ramifications.

Among the most important organizational decisions in the history of BART were those which led, first, to the exclusion of Santa Clara County; second, to the withdrawal of San Mateo County; and third, to the withdrawal of Marin County.[1] With the exclusion of the south peninsula counties BART is not a regional transit system; even in the view of its engineers and planners. (The Legislature provided that counties could be added to the District in the future, and it is possible that, should the core BART system which now exists live up to its more reasonable expectations in levels of serivce, San Mateo and Santa Clara counties eventually will join the District.)

1. Santa Clara County Exclusion

The Legislature's exclusion of Santa Clara County from BARTD, at the County's request, largely was due to the manner in which construction of the proposed system was scheduled in the PBHM report. The system was to be built in three phases. Almost all of the Santa Clara County segment, which involved extension of the line to San Jose, was to be built in the second stage. However, the first stage included construction of a small segment in Palo Alto, which is located in Santa Clara County. This scheme would have resulted in Santa Clara County having to pay taxes for the first stage construction while receiving -- in the Supervisors' view -- little direct benefit from the first phase system. Consequently, by unanimous vote, the Board

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[1]From the earliest estimates, it was understood that Marin County's tax base was insufficient to support the capital costs of its portion of the system. Nonetheless, it was retained in Phase I, according to members of the Board, as an indication of the regional intent. Still, patronage projections justified its reinforcement of the urban centered plan, if not its economic viability.

of Supervisors advised the Legislature, on February 18, 1957, that it did not want to be included in the District.[1]

The Supervisors' reaction was based on local opposition in several sectors. The opposition to increased taxation was strongly voiced by manufacturers in Santa Clara County. The larger manufacturing groups, particularly those with headquarters in the East Coast -- such as Ford Motor Company at Milpitas, FMC Corporation, and Pittsburgh Plate Glass -- resisted Santa Clara County's participation in the new district. The manufacturing interests did not accept the District's arguments that BART would provide a stabilizing economic influence which would benefit all commercial interests in the region. Although the impact BART would have on expanding the available labor force for the manufacturers, especially after Phase II had been completed, was emphasized during presentations in Santa Clara County, the cost/benefit analysis proved unpersuasive.

The BART Commission and its engineers reviewed the possibility of including the San Jose link in Phase I as late as 1956. The event which stirred recognition of the potential justification of an extension to San Jose that year was the disclosure of General Motors' plan for a plant at Sunnyvale. Population data were not available at that time, however, to permit the engineers to justify the early inclusion of Santa Clara County despite this development in the industrial growth of the County.

A second major force against BART in Santa Clara County was the powerful Santa Clara County Taxpayers Association, which dominated county government. The Taxpayers Association was largely made up of agricultural interests, for whom BART would yield few advantages.

Finally, the local impetus in transportation was on a comprehensive program for development of secondary roads. With this positive program toward transportation improvements, which, in turn, would relieve congestion (and assist the agricultural sector), popular support for contributing in taxes to a transit system which would not initially serve the area was muted.

2. San Mateo County Withdrawal

Unlike Santa Clara, San Mateo made its decision to withdraw after the District had been formed, with San Mateo representing one of the five counties. In December, 1961, the San Mateo County Board of Supervisors unanimously rejected the BART plan and informed BARTD that they would not be receptive to further proposals and subsequently removed themselves from the District. San

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[1]The first draft of the legislation would have included in the District only a small portion of Santa Clara County surrounding the Palo Alto terminus. This provision was changed in subsequent drafts to include the entire county of the district.

Mateo's withdrawal culminated a period of a year of reappraisal by the Board of Supervisors. This key decision was the product of several factors.

First, the Supervisors did not want to have their county pay for a system which would serve large numbers of Santa Clara County residents (since the planned San Mateo route would terminate near Palo Alto on the Santa Clara County border) if Santa Clara County would carry none of the tax burden (a result occasioned by Santa Clara County's earlier withdrawal).

Second, there was general recognition that the configuration of the system, at least during operation of the first stage, would tend to promote the development of San Mateo County as a bedroom community for San Francisco. This was precisely during the period when the peninsula was becoming one of the country's leading centers of the aerospace industry. There was widespread feeling that the county's development should be directed toward San Jose not San Francisco.

This sentiment was reinforced by extensive efforts launched by major real estate developers to influence the Board of Supervisors to reject BART. The developers saw the BART system as promoting extensive travel of San Mateo residents to San Francisco for the purpose of retail shopping to the detriment of their subregional commercial ambitions.

It is virtually universally acknowledged among BARTD Commissioners, early Directors, and staff that the commercial realtors' campaign against BART was spearheaded by realtor David Bohannon, who resisted BART not only for the impact it would have on shopping center realty in the county, but for the negative impact it would have on the competitiveness of San Mateo development because of increased taxes. Bohannon's influence with the Board of Supervisors was extremely strong. He and George Keaston, also a land developer, made it clear that Supervisors with further political ambitions should not favor BART's plans. This opposition was supported by Senator Richard J. Dolwig, the State Senator from San Mateo County and a member of the State Interim Committee on San Francisco Bay Area Metropolitan rapid transit problems.

Throughout the entire history of BART's development, nowhere does the land use impact issue become clearer than in the debate in San Mateo County. An important element in San Mateo County's rejection of BART was the successful campaign by local commercial interests to persuade the Supervisors that BART was not simply an efficient transportation system enhancing mobility within existing travel patterns, but

rather was a system designed to change land use and development patterns. The San Mateo debate was a crystallization of the argument over the predicted effect (and perceived interest) of centralization of commerce in San Francisco as opposed to development of decentralized commercial centers.

Third, the anticipated withdrawal of Marin County -- which was foreseen during San Mateo County's deliberations -- resulted in the District's redesign of the system in a fashion which the San Mateo County Supervisors perceived as disadvantageous to San Mateo's interests. A supplementary report based on a four-county plan was prepared in October, 1961 by the engineering consultants. The Marin line was replaced by a line out Geary Boulevard to the northwest area of San Francisco.

According to Homburger, San Mateo's reaction was predictable:

> "The plan was submitted as required by law, to the Boards of Supervisors of the remaining four counties for their approval. San Mateo County found good reason to be unhappy with the proposal: it already had fairly good commuter railroad service and freeway bus routes; the new BARTD route would replace this at high cost and with fewer stations; the industrial area in the northeast corner of the county would no longer be served as it is by the Southern Pacific; service to the south would terminate at the county line instead of at San Jose, thereby severing the connection between San Mateo residential cities and the electronic and aircraft industries of Santa Clara County; and -- perhaps most distasteful of all -- San Mateo's tax rate would rise while Santa Clara's would not, placing the latter county at an advantage in the competition to attract new industries."

Fourth, the Southern Pacific Railroad exerted a substantial influence on the decision of the San Mateo Board of Supervisors. Southern Pacific was opposed to a BART system which would force them to operate the unprofitable remains of their commuter service in Santa Clara County after BART was built in San Mateo County. Louis Chess, a retired Southern Pacific vice president who served as a Supervisor in San Mateo County, was influential in the county's decision. (Southern Pacific could also have gained from cooperation with BART, insofar as BART's sharing of the right-of-way would have permitted a sharing in the cost of grade separating crossings in San Mateo and San Francisco counties, a cost Southern Pacific had not borne despite associated liabilities.)

3. Marin County Withdrawal

On May 15, 1962, the Marin County Board of Supervisors voted to withdraw from BARTD. The decision was the result of lengthy and often acrimonious debate, involving Marin County, the Golden Gate Bridge and Highway District, and the BART District itself.

The BART plan was based on the assumption that the trains would run on a second deck on the Golden Gate Bridge. In May of 1961, BARTD formally asked the Bridge District to allow trains on the bridge, following completion of an engineering study by BART which determined that this was feasible. The Bridge District retained its own engineers to study the matter.

A period of opposition to a second deck by Directors of the Bridge District followed. Homburger attributes the hostility partly to the fact that "the Bridge is owned and operated by a fiercely independent public agency." Homburger further observed:

> "One reason for the vigorous opposition of the Bridge Directors may have been that such an addition as BART had planned (with BART funds) would make a second roadway deck (with Bridge funds) impossible, which would not only create congestion whenever the highway capacity of the Bridge was reached, but would also assure the demise of the District and its Board of Directors in 1971, no new bonds being outstanding at that time. In any case, a group of consulting engineers ruled that the Bridge would be unable to withstand the stresses of a two-track deck and the live loads of the trains. Very soon thereafter, they found that a four or five lane automobile deck would be possible. . . ."[1]

The Bridge District Board voted 9 to 5 to accept their consulting engineers' report. The action generated widespread opposition among the general public and the press. The nature of the opposition is illustrated in a San Francisco News-Call Bulletin article of October 5, 1961, which called the report "doctored" and by the San Francisco Chronicle, on October 6, 1961, which charged much the same thing.

One former BART Director noted that the Bridge District's consultant report made erroneous assumptions about the BART system which were fundamental. For example, the consultant report assumed four trains would be running at a time on the Bridge. BART assumed two. The report assumed that the weight of the cars would be that of standard interurban cars that had been developed up to that time, which weighed 85,000 pounds. However, the BART design was for cars that would weigh approximately 50,000 pounds.[2]

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[1]Homburger, 1966, page 104.

[2]McDonald & Smart interview with John Beckett.

In the context of this controversy over the engineering report's validity, the issue of whether or not the Golden Gate Bridge could support a rapid transit system was still unresolved. The Bridge Board of Directors was insisting that the Bridge's structural strength was inadequate. On March 9, the BARTD Board asked Marin County to withdraw from the District. The reasons that were given were: (1) the dispute over the Bridge's structural capacity to carry trains could not be resolved in time for a four-county plan to go to voters in November (and a non-Bridge borne crossing was financially impossible) and (2) withdrawal of San Mateo County made an East Bay-Marin-San Francisco network financially infeasible.

On March 20, 1962, a report was submitted by a "blue ribbon panel" of engineers retained by the Golden Gate Bridge and Highway District to resolve the issue of the feasibility of running trains on the Bridge. The panel reported that trains should not be allowed on the Bridge. BARTD Directors representing Marin County were critical of the report and suggested that the Golden Gate Bridge and Highway District be placed under the jurisdiction of the California State Toll Bridge Authority.

After threatening to sue BARTD for $250,000, which was approximately the amount that Marin County had invested in the District, the Marin Board of Supervisors voted unanimously on May 1 to withdraw from the Bay Area Rapid Transit District. However, as part of their statement of willingness to withdraw, Marin County asked for reimbursement of $31,000. The BARTD Board replied that they must withdraw immediately or risk having their property owners taxed for support of the three-county system. On May 15, the Marin County Board of Supervisors agreed unconditionally to leave the District.

Through the process described above -- i.e., a series of political decisions produced through the framework of "localism" which remains the foundation of the vast majority of the country's brick and mortar program decisions -- the planners' dream ended up a mere shadow of its original self. The "Bay Area Rapid Transit District" became a misnomer. The system to be built was no longer a "Bay Area" system; rather, it was in large part an East Bay-San Francisco commuter line.

To be sure, the portion of the originally planned system which remained was the core of the system, serving the most intensively developed areas. Also, it had a modest distribution capacity in outlying areas of all three counties. But, whatever its functional advantages to the counties that remained in the District, the ultimate configuration of the system -- produced by political realities rather than master planning concepts -- was not the original planners' version. Furthermore, the District had lost a significant source of both patronage and revenue from San Mateo County. Marin County, of course, could also have provided considerable patronage; the capital costs of extending BART tracks across the Bay and through Marin's occasionally rugged terrain, however, made access to this patronage considerably more expensive than access to San Mateo's.

D. Interaction Among Key Actors in BART's Early History

The first two sections have documented principal threads of influence which led to major organizational decisions, reappraisals, changed decisions, formation of the Bay Area Rapid Transit District and the events which resulted to its present political and geographic composition. It is often asked who the responsible individuals were who fostered the concept of regional rapid transit for the Bay Area. Some would contend it was San Francisco's corporate community; others would contend it was this or that single individual, whether a political figure or private individual. Neither is true.

Financial, commercial and industrial interests in San Francisco played a significant role in BART's early history, although not through any unified strategy so much as through the efforts of a number of individuals who participated in the public representation necessary with a public activity. There is no evidence that these individuals represented corporate objectives except as their beliefs, given their professions, were biased toward concepts of economic and urban development, and the role of transportation in that objective. Nonetheless, as Figure II-1 illustrates, many of the key actors from BART's genesis continued to be involved with BART, not only in its planning, but in the financing and construction of the system.

This figure is not meant to be exhaustive, merely illustrative. Many additional key actors are further identified in subsequent sections dealing with financial decisions and construction.

FIGURE II-1

ILLUSTRATIVE INTERACTION AMONG KEY ACTORS[1]

Individual Actors	Professional Affiliations as Officers, Directors, or Elected Officials																		BART-Related Activities					
	Engineering				Banking					Industry					Re-search	Public & Gov't.		La-bor						
	Parsons-Brinckerhoff-Quade and Douglas	Tudor Engineering	Bechtel Corporation	Kaiser Industries	Bank of America	American Trust	Crocker Citizens	Wells Fargo	Blyth, Eastman, Dillon & Co. (then Blyth & Co.)	Bethlehem Steel	Kaiser Industries	Standard Oil of California	Pacific Gas and Electric	Westinghouse	Stanford Research Institute	Board of Supervisors	Chamber of Commerce	Labor Unions	Bay Area Council, 1945	Bay Area Rapid Transit Committee, 1949	Bay Area Council Committee on Mass Rail Transit, 1950	Bay Area Rapid Transit Commission, 1951	Bay Area Rapid Transit District, 1957	Citizens for Rapid Transit, 1962
Stephen D. Bechtel, Jr.			X				X								X				X					
William Waste			X																					X
Leland Kaiser				X																				
Mortimer Fleishhaker							X														X			X
Kendric B. Morrish						X		X									X				X			X
Carl F. Wente					X																X			X
Marvin Lewis																X				X		X		
John C. Beckett																						X		
Clair W. MacLeod																						X	X	
Sherwood Swan																						X	X	
Arthur J. Dolan, Jr.									X											X		X	X	
Adrien Falk																	X		X				X	
Alan K. Browne					X												X			X		X		X
Thomas A. Rotell																		X	X			X		
H. L. Cummings																X			X			X		
Corporate Action																								
Funded Bay Area Council			X		X	X			X			X	X											
Funded Citizens for Rapid Transit	X	X	X	X						X	X			X										
Received BART Contracts	X	X	X	X					X	X	X		X	X	X			X						

III. TRANSITION FROM PLAN TO IMPLEMENTATION

Most of the conceptual decisions which would shape the Bay Area's rapid transit system were formulated in the early years, beginning with broad outline terms in the 1956 "Regional Rapid Transit" report and further refined between 1959 and 1961 in preparation for the bond election. The early planning phases focused on culmination at the bond election, when implementation could begin. Once the electorate had approved the issuance of general obligation bonds for construction, the District would have its mandate to proceed.

Reaching the point of a plebiscite was by no means an easy task. The Commission's 1957 report to the Legislature recommended a bond election 36 months after forming a district. This would have meant holding the election in the fall of 1960. Even prior to the surfacing of engineering and political issues which would reduce the scope[1] of the first stage of construction from five counties to three, system design and engineering were taking longer than expected.

System design and engineering were entrusted to a joint venture, led by the firm which developed the preliminary planning contained in "Regional Rapid Transit." Parsons, Brinckerhoff, Hall and MacDonald had developed the regional transportation plan. In order to complete design and engineering of the system, to accurately cost out the system and eventually to manage construction, two major Bay Area based engineering firms, Bechtel Corporation and Tudor Engineering, teamed with Parsons, Brinckerhoff to create the Joint Venture, known as Parsons Brinckerhoff-Tudor Bechtel (PBTB), which has been responsible for completing the early plans.[2]

The engineering report on the five-county system was not completed until June, 1961. That report was still subject to approval by the respective counties' Boards of Supervisors prior to placing the bond issue on the ballot. As discussed earlier, San Mateo and Marin were to be eliminated from the system by this process (or its impacts); thus, the engineers designed two additional systems, the first comprising four counties and then three. The final three-county

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[1] Six counties, including the southern terminus of the peninsula line in Santa Clara County which was originally invited to participate.

[2] Discussion of consultant selection is contained in Section III-F (4 and 5).

engineering report was contained in the so-called "Composite Report" on Bay Area rapid transit, dated May, 1962. This Composite Report incorporated the studies of the joint venture on engineering the system, and studies of three separate consultants on the financial and economic phases of the rapid transit plan.

The financial consultant responsible for the financing plan was Smith, Barney & Company of New York. The financial advisor to the District was Stone & Youngberg, a municipal bond consultant, which evaluated the impact the financing plan would have on local tax rates and bonding capacity of other local agencies. Finally, Van Beuren Stanbery provided an analysis of the Bay Area economic trends which affected the need for rapid transit, as well as economic arguments for rapid transit (an elementary precursor of economic impact studies).

The financial and economic emphases of the Composite Report were subordinate to, and responsive to, the engineering concept of the system (although the actual system design did permit flexibility in tailoring the system, as opposed to the concept, to the eventual bonding capacity). The financial implications of the system did not constrain the concept. B. R. Stokes, BARTD's general manager from 1962 through 1974, was even to claim that the cost of the system had to be as high as it was to gain public confidence. Nonetheless, the fate of the concept was dependent on the willingness of local residents to bear the cost.

A. Financing Plan

Engineering represents only the visible, and physical, implementation of a regional rapid transit plan. As important for implementation were the vital decisions which forged a means of financing rapid transit. In the case of BART, review of financing alternatives gained significance from the magnitude of the costs associated with building a new transit system. Although the first capital cost estimates would not be made until completion of the PBHM "Regional Rapid Transit" study in 1956, no one deluded himself, even during the course of test study, about the magnitude of the costs which would be associated with BART.

A considerable number of alternatives were studied by a series of financial consultants. In many respects, the financing plan was determined by the size of the capital requirements for BART and the early assumption of BART's potential for revenue generation through the fare box.

It is important to note that the consultants' projections that revenues would exceed the expenses were predicated, according to an early Director " . . . on a five county system and counted heavily on the patronage from San Mateo County." Furthermore,

"PBTB never claimed, and in fact cautioned against, any assumption that a three-county system could operate without a deficit."[1]

Initial estimates of capital requirements for the first stage system approximated $875 million.[2] Clearly, this sum could not be covered out of eventual fare box revenues. Therefore, it was necessary to seek some other form of public support. Since construction was perceived as a 5-year program, tax support needed to reach as much as $190 million per year. Bond financing, then, seemed inevitable. Given the magnitude of the capital required, the number of politically acceptable revenue sources which could support a bond issue of this magnitude was limited.

The 1962 financing plan, which relied heavily on property tax and toll bridge revenues, proved less than flexible in meeting later unanticipated financial requirements because of an early misconception in BART's planning. The engineers' patronage projections and operating cost estimates indicated BART's operations would generate revenue in excess of expense. Thus, it was assumed that many of the financial contingencies which eventually required BARTD to seek ad hoc financing solutions could be covered from surplus revenues. The financing plan did not address long-term financial requirements; rather, it was believed that, first, initial construction funds would be sufficient, and second, financing of systems operation, rolling stock, and service expansion could occur out of the fare box.

These two considerations established a tenor for all financing plan evaluations. Unless construction costs were controlled and fare box revenue exceeded operating expense, the financial plan for BART would be insufficiently comprehensive and flexible to serve the financing needs. However, the plan was based on a series of studies which conscientiously reviewed alternatives. This Section reviews the considerations of each.

1. Organizational and Financial Recommendations to the BART Commission, 1956

In November, 1954, the Commission retained Stanford Research Institute (SRI) to prepare a study and report a practical means of financing the capital costs of the regional rapid transit plan recommended by the engineering consultants. SRI's assignment also included a recommendation on the type of agency which should construct and operate the proposed transit system.

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[1]Beckett, ibid.

[2]Cited in Stanford Research Institute's study on Organizational and Financial Aspects of BART, for the BART Commission, 1956.

Organizational alternatives were treated quite simply -- little discussion appeared to have occurred among active participants in this early planning period. The type of organization to implement the transit system would necessarily be regional in scope, and either an authority or district in form. Although recommendations to the Commission pointed out that a regional authority would have the advantage of freedom of administrative action in controlling the transit program, this freedom had to be weighed against the fact that authorities normally rely upon revenue bonds issued without voter approval. Since revenue was insufficient to guarantee bonds to finance the capital costs, the authority form of organization was deemed inadequate (despite rhetorical enthusiam for the potential for independent action). Thus, the district form of government, responsive to local voters familiar to Californians, and capable of issuing bonds based on the faith and credit of the area, was recommended.

Sources of financial support were reviewed with greater attention to alternatives. Consultants' recommendations were made in the context of concern over large outlay needed in a relatively short period of time and the apparent venturesomeness of the undertaking, faced as it was with the inability to pay its own way from income. Thus, the choice of sources proved somewhat limited. Attention was focused on potential sources of support which alone could provide the funds for debt service since it was perceived that, from both an administrative and a political point of view, a financing plan based upon numerous sources would be virtually impossible. The issue was also raised that a financing plan based upon several sources of support would be less well-received by the bond market. These two decisions determined the relative inflexibility of the later plan.

The feasible choices of revenue sources considered by SRI were familar to transportation or special district activities: fare revenues, bridge tolls, taxes on tangible property, retail sales taxes, gasoline taxes, and general state or federal aid.

The principles which were adopted as criteria for selection of public financing sources were also conventional in nature.[1]

-- The yield should be large enough and dependable enough to meet the total capital requirements.

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[1]San Francisco Bay Area Rapid Transit Commission Report to the Legislature, State of California, December, 1957, page 107.

-- Benefits conferred by the transit system should bear reasonable relationship to the financial responsibility assumed by those who pay for it.

-- The charges, assessments, or levies made for rapid transit should be related equitably to the ability to pay for them.

-- The financing method used should not result in unfair subsidy to any public or private enterprise, where another enterprise with the same aid could accomplish a better result in providing either rapid transit or some other service equally essential.

-- The financing method should have a rational effect upon passenger transportation so that optimum utilization of facilities would be obtained and the traffic flow would be most benefited.

-- Any limitations in conflict to the methods employed should be so balanced as to result in a feasible program for raising the funds.

Each potential source of revenue was reviewed against these criteria. No rigorous evaluation was included in the 1959 report, although arguments in favor of and against various taxing schemes emerged.

a. Fares and Other Transit Revenues

Most of the ideals set forth in the criteria could be achieved by reliance on fares as user charges. Fares were considered inadequate as the sole basis of financing. First, fares were conceived as providing only half of the total annual financial requirements,of the District (including debt service). The engineers were estimating that fares would provide surplus revenue of approximately $29 million annually. Secondly, reliance on fares would motivate an attempt to obtain maximum fare revenue, which would work counter to the objective of maximizing use of the transit system, with attendant reduction in congestion by motor traffic. Reliance on fares alone would tie the District's transit objectives closely into its financial requirements, to the detriment of policy flexibility. Finally, reliance on revenue bonds for construction would probably have prevented introduction of variable fares (higher peak-hour fares were still being considered) since consistency in fare policy would be a necessary requirement for bond market confidence. Thus, while fares and transit revenues were considered relevant to cover operating finances, they were inadequate for capital financing.

b. Bridge Tolls

Bridge tolls were considered among the available financing sources from the earliest planning days, since any inter-urban rapid transit system would require crossing of the Bay. When the engineering study determined that a subaqueous crossing was most appropriate for the rapid transit system, arguments were raised that any rapid transit crossing would relieve congestion on the existing bridges, reinforcing fulfillment of the objectives of the Toll Bridge Authority. By this action, rapid transit should be entitled to sub-ordinated access to bridge toll revenues.

Since the San Francisco-Oakland Bay Bridge had retired the initial bond which financed its construction, tolls provided a financial resource totaling $9 million per year, pledged to support bonds for additional crossings for the Bay. A transit crossing of the Bay was not excluded from this resource.

Stanford Research Institute also considered bridge tolls in the context of a unified pricing policy for transit and automobile use. The consultant stressed the importance of correlating bridge tolls and transit fares in order to achieve optimum traffic flow and the most rational program of future construction. Evaluation of coordinated pricing, in a sense congestion pricing, between tolls and fares was remarkable for 1959. These recommendations were made in a period of optimism over the unifying role which rapid transit would have within the region. While BARTD has cooperated with several state and local agencies, the type of cooperation necessary for a unified fare policy has not occurred.

c. Property Taxes

A general property tax was considered essential to transit financing from the earliest analysis, since faith and credit of the transit district was necessary to make transit bonds of the magnitude necessary marketable in economic terms. This judgment of the property tax's indispensability, when considered in the framework of formulating a financing plan with a minimum of different sources, essentially eliminated many alternatives. Although the tax need not be collected to support the entire debt service expense, only with the District's legal capability to levy the property tax could the interest rate on bonds be kept low.

Among the justifications for using the property tax was the argument that Bay Area property owners, in general, would enjoy enhanced values as a result of the transit system. Furthermore, most businesses would be able to draw customers and employees from a wider area as a result of transit. One explicit consideration which was not sustained in later studies was the use of a transit zone within the District in which higher taxes would be paid than in outer areas not benefiting equally from the provision of services. SRI's treatment of this recommendation was somewhat ambiguous, suggesting merely that future studies focus on this potential differentiation.

d. Regional Retail Sales Tax

A regional retail sales tax was strongly advocated as a source of revenue in the report to the Legislature. It was considered a highly effective means for spreading the tax burden throughout the entire area and for diffusing it among all classes of people. If kept at less than 1%, it was considered to be reasonably acceptable to the public and adequate for meeting the debt service charges for the District. In 1956, the retail sales tax was firmly established in California; it was the largest source of income for the state. Furthermore, it yielded for California double the amount collected by any other state from any source.

Nonetheless, the sales tax suffered in respect to the ability to generate principal and could not be as closely connected with rapid transit as fares, bridge tolls, or even property taxes were. Opposition to use of the retail sales tax would inevitably come from those who felt the sales tax should be preserved for more traditional functions and also by the merchants who felt their sales might suffer. Finally, there was concern over the regressivity of the sales tax.

e. Regional Gasoline Tax

A gasoline tax, or sales tax on gasoline sales, was considered because of its natural relationship to overall transportation goals. SRI estimated that a $0.03 per gallon tax in the BARTD region would provide sufficient revenue for debt service. Unfortunately, it was given little likelihood of being acceptable to the Legislature, which faced the influence of highway interests. Further, even the consultants felt that highway revenues were insufficient to meet contemporary highway needs, militating against diversion of highway-related funds.

f. State and Federal Aid

In 1956, there was little confidence in receiving external aid from either the state or federal governments. This was well before massive assistance programs to mass transit were available.

In discussing the potential for external aid from the state, SRI's report indicated that state aid was probably not justified because of the difficulty in quantifying the benefits which a regional transit system would confer on areas outside of the region and because the Bay Area was not incapable of financing the system itself. Loans from the state, on the other hand, were advocated to permit the acquisition of rights-of-way early in the construction program.

Little encouragement was given to seeking federal aid for rapid transit, although the implication of SRI's recommendation was that a case for federal aid could be made on the basis of national defense, aid to military personnel and civilian employees in defense establishments, and savings in the freeway program into which federal funds flow. Nonetheless, aid to a transit program in response to these justifications could only occur on the basis of new federal programs which would apply nationally to mass transit. In effect, BARTD was to be responsible for just such federal programs.

2. Legislative Requirements

Based upon recommendations contained in the SRI report, the financial elements of the enabling legislation for BARTD were drafted. To this extent, the SRI report had a significant impact in directing future financial decisions.

The San Francisco Bay Area Rapid Transit District Act (Chapter 1056 of the Statutes of 1956) required economic and fiscal experts to prepare reports to enable the Board to determine the feasibility of the entire system prior to submitting a proposal to incur bonded indebtedness. In the Board's desire to employ the most respectable professional assistance, Smith, Barney & Company of New York was hired as the financial consultant for the financial plan. Their responsibility included a statement of the amount of bonds required to pay the estimated total cost of constructing the system, the amount, if any, which the District determined was necessary to provide for payment of bond interest during the construction period and for 3 years or less thereafter, and an estimate of taxes required to be levied for all District purposes and the sources from which these taxes would be derived.

Within the mandate of the legislation, the District was capable of issuing several types of obligations.

a. General Obligation Bonds

The primary source of revenue for the capital requirements of the District, as emphasized in the SRI report, was determined to be general obligation bonds. Placing the proposal to authorize general obligation bonds on the ballot was subject to approval by each of the Boards of Supervisors of the counties comprising the District. While Stokes contends that San Mateo would have remained in the District if the decision to place the proposal on the ballot had gone to the people, the legislation did not specify going to the voters to determine whether the bond issue proposal would be on the ballot.

Once approval had been gained by the Boards of Supervisors of each of the counties, the District was to prepare a proposal for the electorate within the District. Bonds could be

issued after the District had received a two-thirds favorable vote on issuing the bonds. The requirement of two-thirds approval was a significant issue. Later amendments of the act would permit the bond issuance to occur with three-fifths approval instead, an essential change given that electoral approval was given by a 61% vote.

The only restrictions on the nature of general obligation bonds were that the interest was not to exceed 6%, maturity was not to exceed 50 years, and the amount of general obligation bonded indebtedness was not to exceed 15% of the assessed valuation of taxable property within the District. (This was interpreted to mean the District could authorize and submit to the voters a bond issue which exceeded 15% of current assessed valuation, but that the amount of bonds being issued could not exceed 15% of the assessed valuation at the time of sale.)

b. Revenue Bonds

Although it was to prove a moot point, the legislation also permitted the District to issue bonds payable from revenue. These revenue bonds could be issued without voter approval, once the general obligation bonds had been adopted by a vote of the qualified voters of the District. As a subset of revenue bonds, the District was permitted to finance equipment purchases through the use of equipment trust certificates, which would be repaid through revenues.

3. Special Assessment Bonds

In addition to the other bonding instruments permitted the District, the District was capable of financing acquisition of construction through special assessment proceedings similar to those available to other special districts.

4. Other Bonding

In two cases, BART improvements were financed locally by bonds. In Berkeley, the city established a special tax district to finance undergrounding the track and in San Francisco, tax increment bonds were issued by the Redevelopment Agency to complete the Embarcadero Center Station.

5. Taxation

The Board of Directors of BARTD was given the power to collect property taxes sufficient to meet all future principal and interest requirements on the debt necessary for initial construction. For all other purposes, the District could levy a $0.05 tax per $100 of assessed value for administrative purposes.

6. Financing the Transbay Tube

The potential of toll bridge revenues as a source of funds for BART construction was identified in the SRI report in 1956, as well as by the engineers early in their deliberations, although those funds were not to be earmarked for the tube until the financing plan's completion. Then, as now, consideration was given to taxing the highway user for the task of relieving congestion. Assigned toll revenue from the Division of Bay Toll Crossings for a transit crossing of the Bay, which would relieve pressures of automotive congestion on existing crossings, was a natural conclusion of this argument. SRI's consideration of toll revenues, however, preceded the legal action which eventually permitted toll revenue diversion. Diversion of toll revenues was actively pursued by the District in Sacramento. By the time Smith, Barney & Company began to formulate the financing plan in October, 1959, the California Legislature had already approved the use by BARTD of tolls from the Bay Bridge to construct an underwater tube between Oakland and San Francisco.

The legislative authorization, which passed both houses in July, 1959, was fought bitterly by Senator Randolph Collier, Chairman of the Senate Transportation Committee and a strong advocate of highway construction. Senator Collier was opposed to diverting any highway funds to other purposes, but Governor Edmund Brown, Sr. is said to have intervened and persuaded the Senator to let the bill out of committee. The bill did not leave committee without conditions, however, which, to the Senator, appeared to represent substantial hurdles to fulfillment. One of these conditions required that the approved bond issue in support of captial requirements for the District would exceed $500 million, a sum virtually unheard of in locally financed public works up to the time. Secondly, this public commitment had to be made within 4 years.

Neither of these restrictions ever neared posing a defeat for the system. Furthermore, other hurdles were overcome as the Board obtained amendments of state and federal legislation which otherwise would have prohibited state participation in diverting toll revenues to assist in the financing of a rapid transit tube.[1]

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[1] Public Law 154, 83rd Congress (which amended Section 2 of Pubic Law 695, 71st Congress giving congressional consent to the construction of the Bay Bridge) provided that tolls were to be collected on the Bridge to aid in financing construction of not to exceed two additional highway crossings of San Francisco Bay and their approaches. At the time of consideration, the restrictions in the federal law appeared to prohibit a pledge of revenues of the San Francisco-Oakland Bay Bridge to assist in the financing of a rapid transit tube. Further, and equally significant, they would operate to prevent the Authority from putting all toll crossings of San Francisco Bay under one bond indenture as has been suggested as a possibility for financing the tube. All of these stipulations were changed.

An unexpected bedfellow in the question for diversion of bridge toll revenues was the California State Automobile Association. On the basis of concern over the capacity and the safety standards of the Bay Bridge, which could be greatly improved by eliminating opposing traffic on the upper and lower decks, widening the traffic lanes, and eliminating the train tracks, highway interests were strongly motivated to find an alternative for a rail crossing of the Bay. Had it not been for this support, achieved largely through the efforts of Clair W. MacLeod, the BART District's first President, it might not have been possible to obtain financial support from bridge tolls to construct the subaqueous tube.

BART also had a significant supporter in Governor Brown. He fully supported the system, and often provided an "invaluable" impetus to BART's legislative endeavors, according to Stokes. The opposition could be mighty, particularly in the form of the highway-oriented legislators. Legislative opposition, however, had to deal with the public works encouragement of Brown, and the unanticipated scope of the Board's proposal and determination.

Chapter 1755 of the Statutes of 1959 directed the California Toll Bridge Authority (TBA) to undertake the financing of the San Francisco-Oakland rapid transit tube, a vital link in the system as planned. According to this statute, the Toll Bridge Authority would issue revenue bonds to finance the construction of the transbay tube and the Department of Public Works would construct it. The revenues from the San Mateo-Hayward, Dumbarton, and Bay Bridge tolls would be available for pledge by the Authority as security for the revenue bonds issued to finance construction of the tube.

Furthermore, the Authority was directed to finance construction of the approaches to the tube, a portion of the right-of-way defined as the track between the first station on either side of the tube and the tube itself. While the District was obligated to reimburse the Authority for costs of these approaches, this financing arrangement permitted BART's use of borrowed funds. The importance of using borrowed TBA funds is underscored by the Embarcadero Station omission in early plans. The absence of an Embarcadero station in the earlier plans was based partially on a financial impetus to maximize the distance between the first station and the tube itself, and thus, capitalize on the financing obligation of the Toll Bridge Authority. When the city requested the Embarcadero Station, thus shortening the western approach, BART still received TBA funds for the tunnel as far as Montgomery Street. Still, this financing attitude assumed the notion that operating revenues would accumulate.

Operating revenues were expected to pay for the approaches; instead, an accounting transfer occured, balancing a BART advance to the Division of Highways for joint right-of-way

improvements with the Toll Bridge Authority's financing of tube approaches. It was agreed that repayment of the cost of building approaches ($55.6 million) would occur through cancelling the Division of Highway's application of $16.5 million debt to the District as a result of BART financing of highway improvements in joint rights-of-way, and applying a payment schedule of $1 million in 1977, and annual payments of $2.5 million from 1978 until the balance was paid.

Once the initial financing obligation of the Toll Bridge Authority was made, negotiations were relatively uncomplicated in returning to the Legislature to request an additioanl appropriation for the ultimate costs of transbay tube financing, after the bids reflected the impact of inflation. The Toll Bridge Authority advanced $14 million to BARTD, issued $100 million in revenue bonds in December, 1965, and paid the balance on the tube and approaches (summing, all told, $180 million) from net revenue derived from operation of Bay bridges.

B. The Financial Plan, 1962

The gist of the financial plan prepared for BART by Smith, Barney & Company was both conventional and uncontroversial. Essentially, it expanded on the recommendations presented in the SRI report of 1956. Of course, there is little unusual in this event. The extraordinary concept of BART was the system; cost was not a constraint at the conceptual stage. While the Board was not composed completely of influential members of the industrial, financial and commercial community -- experienced in wielding overwhelming financial powers -- the Board's leaders and BART's advocates, who had defined the concept were.[1] A natural confidence ensued. Thus, the guiding concern in financing the system was to provide a rapid transit system at a cost which would not exceed the upper bounds of political acceptability, without compromising the standards of service. The Board felt it had to be expensive to fulfill its potential. On the other hand, the Board recognized that the public could be conditioned, through public information and education, to accept both the system and the cost.

In 1962, however, the Board fully understood the price the engineers were estimating. The enabling legislation restricted the bonded indebtedness to 15% of assessed value. Thus, there was a limit on the amount of funds which could be raised through General Obligation bonds. This meant that the total bonds outstanding at the end of any year could not exceed 15% of the estimated assessed valuation. This did not necessarily shackle the total estimated costs of the system to $792 million, since the dollar value of the 15% limitation increased each year as assessed valuation increased.

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[1] McDonald & Smart interview with Richard J. Shephard, Secretary to the Board of Directors, Bay Area Rapid Transit District.

By extending the period of time for construction, the bonding capacity could be increased. The financing plan, as formulated, however, called for a nine-year period of bond issuance, by which time 15% of the estimated assessed valuation would equal $792 million.

While system costs and bonded indebtedness to meet them, could have increased by extending the construction schedule, John Peirce, the District's first General Manager and the former State Director of Finance, estimated that $800 million would be the maximum acceptable to the public. Thus, it became the upper bound against which cost estimates were made and the financing plan developed. Smith, Barney & Company's mandate was to formulate a financing plan for BART's requirements. Conventional financing sources were recommended by them.

The fixed basic elements of the system were to be financed by the issuance of general obligation bonds of the District secured by pledge of "the District's full faith and credit." It appeared that the District had sufficient borrowing capacity for this purpose over the planned period of construction.

Purchase of rolling equipment was to be financed primarily by the issuance of revenue bonds secured by pledge of the gross operating revenues of the system. These revenues appeared to Smith, Barney & Company to be adequate to provide a suffi - cient base for rolling stock financing on the basis of estimates by the engineers.

This financial plan altered no predictable patterns of financing. Naturally, the magnitude of the financial offering, $792 million, was extraordinary; it exceeded in sum any previous offerings by local governments in the country. The nature of that financing, however, was highly predictable.

Three routine bonding principles guided the schedule of maturities which Smith, Barney & Company adopted. First, the average life of the bonds should be no longer than the estimated useful life of the basic fixed elements of the system. Secondly, the maturities of the bonds should be scheduled in such a manner that the tax burden for debt service would be allocated equitably over the life of the bonds and, at the same time, provide the necessary flexibility for the issuance of additional bonds as subsequent stages of construction or major items of remodeling or improvement proved necessary or desirable. And, finally, the maturity schedule was designed to appeal to the broad investment market and thus attract as favorable bids as possible.

Actually, the second consideration was important in psychological terms, though it was probably not treated in terms of financial analyses. Few of the BARTD Board members or consultants doubted they were planning a regional system which would expand to at least two more counties. Even now, the engineers and staff members involved in early planning speak in the visionary terms of expansion to a regional system. But the financial plan failed to address, explicitly, the manner of financing appropriate to marginal expansion, which would simultaneously benefit and encourage expansion by other counties which must acknowledge the future costs of BART.

As far as marketability is concerned, the consultants were perspicacious, to say the least. The financial consultants estimated in 1962 that the average yield on the full bond issue would be 4%. In reality, the average yield was 4.14%.

C. The Bond Election of 1962

All of the design, engineering, and financial planning which was conducted through 1961 was only a prelude to the most important event necessary for implementation of BART: the public approval of $792 million of general obligation bonds, to be paid for by property taxes within the District. Clearly, a substantial public information program was necessary to inform the public of the need for rapid transit and the reasonableness of the cost. The importance of a strong public information effort was emphasized as early as the preliminary DeLeuw, Cather report in 1953. This need was reiterated in the Commission's report to the Legislature in 1957.

The focus of a public information effort exceeded merely good will; a strong campaign was waged to urge bond issue approval. After all, $792 million was nearly twice the three counties' existing bonded indebtedness; net overlapping debt of all local jurisdictions within the District stood at $410 million in 1962.[1]

As early as 1958, the staff at BARTD was reviewing bond issue voting records within the Bay Area to determine the likelihood of passing a bond issue with 2/3 electoral majority. Of 60 bond propositions voted upon in the Bay Area between 1948 and 1958, 47% failed. Half of those which failed, however, would have passed if the required affirmative vote were 60% instead of 2/3 majority. Thus, the chance of success of the BART bond issue election would increase from approximately 50% to more than 75% (based upon historical data), if only the

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[1] "Net overlapping debt" is the most commonly used measure of total debt. It is determined by deducting from the gross total the amount of self-supporting debt.

voting requirement were reduced. If the voting requirement were reduced to a simple majority (50%+), historical data would indicate that the chance of success would increase to 95%.

BART also commissioned opinion polls from Penfield Associates which revealed a level of support of approximately 60%.

Yet the statutory acceptance terms for BART were based upon its enabling legislation alone. Except as created by special statute, special districts are normally subject to only a majority vote (according to Article XI, Section 18 of the State Constitution). Thus, in 1959, BARTD explored the possibility of seeking legislative approval to revise its voting requirement to a simple majority. The culmination of this effort, however, did not occur until June, 1961, when BARTD submitted a bill to the Legislative to reduce the requirement of a 66 2/3 majority vote to 60% for BARTD.[1]

One positive step toward improved voter concurrence in the rapid transit plan was lowering the necessary electoral acceptance. More signficant was the formation of Citizens for Rapid Transit, a blue ribbon committee encouraging rapid transit for the Bay Area. Citizens for Rapid Transit was comprised of the same leaders of industrial and commercial interests in the urban centers who fostered the idea through the various committees and commissions. Finance Chairman for the citizens' committee was Carl Wente, Chairman of the Executive Committee of Bank of America. Another prominent member of the Committee was James D. Zellerbach, Chairman of Crown-Zellerbach Corporation. This distinguished group of citizens was assembled to convince the public of the wisdom of an interurban rapid transit system. One of the chairmen of the citizens' committee reportedly stated: "It will be our job to bring the facts about the program to the people who are going to vote on it. We regard ourselves as an educational organization, not a propaganda one."[2] Thus, Citizens for Rapid Transit formed two-man speaking teams of prominent civic leaders and BARTD staff personnel to make presentations throughout the District.

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[1]Palatability of the measure to reduce the vote requirements was enhanced in the Legislature by linking it to a measure to permit elected officials to serve on the Board. Initially, local politicians were unconcerned about being unable to serve because of the uncertainty it would succeed. At the juncture of the bond election, however, this measure would permit them to serve only if it <u>did</u> succeed.

[2]Norman Kennedy, "San Francisco Bay Area Rapid Transit System, Promises, Problems, Prospects," a paper presented at the 1971 SAE National Convention, Melbourne, October 19, 1971.

This effort was reinforced by the Bay Area Council, which also sponsored meetings. The Council's Chairman, who was also Chairman of the Board of Bechtel Corporation, told East Bay business and industrial leaders that rapid transit was absolutely necessary to enable continued economic growth in the area. The President of the Bank of America warned this might be the only opportunity to approve a rapid transit system. Members of the Citizens for Rapid Transit included members of the Bay Area Council, the Joint Venture and business interests. They hired Henry Alexander, a San Francisco publicist, to direct the campaign to "educate the public." This was accomplished with $220,000 raised within the citizens' committee, including substantial contributions from firms making up the Joint Venture.

In June of 1962, Alexander began the campaign which he designed to alert the public to the basic need for transit, and, understanding that need, to know what the ballot issue concerned, where the issue was on the ballot, and how to vote in favor of rapid transit. In fact, Alexander was adamant that in the little amount of time remaining before the election the point was to condition the voters to "vote yes" on the bond proposition, rather than educate them to concepts or numb them with facts.[1]

The campaign included speaking engagements in all counties, some limited use of television, radio announcements directed at both the informed and uninformed, emphasizing the need to "Vote Yes on A." At this time, the newspapers were generally favorable, with sympathetic coverage and editorial endorsements from the San Francisco Examiner, the San Francisco Chronicle, and the Oakland Tribune. One of the more effective mediums in the campaign was a single billboard on the western end of the Bay Bridge which was undergoing improvements, exacerbating congestion. The frustrated commuter would emerge in San Francisco to be welcomed by the message, "Rapid transit. Don't you wish you had it now?".

The election of November 6, 1962 was successful. In 1962, the success of the opposition had not yet whetted the appetites of citizens groups. There was little organized or expressed opposition to BART.

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[1] McDonald & Smart interview with Henry Alexander, December 6, 1974.

A detailed analysis of the total vote, including absentee ballots, showed a total affirmative vote in the District of 61.22%: 60.04% in Alameda County, 66.89% in San Francisco, and 54.48% in Contra Costa. The City and County of San Francisco carried the election, with yes votes exceeding no votes in every census tract. Even in the northern sections of the City, which would not be served by the proposed system, the vote for the bonds was very high.

If the vote had been by county rather than district, BART would have become a two-county system, economically infeasible. The total vote, however, was favorable..

In Alameda County, the eastern area of the county, which would not be served by the proposed system, produced the lowest proportion of affirmative votes. Considerable opposition toward the transit system surfaced in Albany, where an intensive campaign against the bond issue was waged by city officials and civic leaders who deplored the specific routing as planned. Only 30.5% of the voters in Albany (excluding University Village) voted "yes." The generally conservative section of southeast Oakland also voted in opposition to the plan.[1]

With the exception of Albany, the most active campaigning against the proposed issuance of rapid transit bonds occurred in Contra Costa County. While in El Cerrito specific routing was the issue behind the negative response, in the unserved eastern sections of the county the entire system was opposed. In fact, it was this opposition in the eastern portion of the county which almost resulted in the Board of Supervisors failing to place the proposition on the ballot earlier in the year. (The vote was 3 to 2 in favor of the proposition, although only after last minute advocacy by representatives of the other counties and Governor Brown.)

While it is difficult to isolate specific reasons for strong support of the bond issue, as the Citizens for Rapid Transit emphasized, there was an urgent need for a rapid transit system in the Bay Area, it would maintain the strong central business districts in San Francisco and Oakland, enhance real estate values, and overcome the inadequacy of an "all highway" solution.

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[1] Wolfgang S. Homburger, "An Analysis of the Vote on Rapid Transit Bonds in the San Francisco Bay Area," Institute of Transportation and Traffic Engineering, University of California, June, 1963.

Three specific reasons for opposition have been cited in Homburger's analysis: (1) opposition to specific routes, particularly elevated routes and the fear of disruption of the community, e.g., in Albany and El Cerrito; (2) opposition to the project because it failed to provide immediate benefits to the community, a justifiable concern in eastern Contra Costa and Alameda counties; and (3) less specifically, the concern on general fiscal grounds based on opposition to public debt and the prospect of higher real estate taxes.[1]

Despite this opposition, BARTD had received its mandate and the financing for its capital construction. The staff and engineers, armed with nearly $1 billion of available financing, (including Toll Bridge revenues and anticipated revenue bonds) were eager to proceed.

D. Supplementary Financing

In 1962, the District Board and staff enjoyed unhampered euphoria over having adequate funding to fulfill the rapid transit mandate; by the end of 1965, it became clear that the unanticipated costs of dealing with community demands after preliminary planning had been completed, plus inflation which occurred during unscheduled delays, had increased the cost of the envisioned system. The reasons for many of these cost increases are documented in Section IV. The impact, however, was felt in the need for additional financing, in the void of legislative authorization.

In July, 1966, a full revision of all cost estimates was completed by the Joint Venture. This estimate reflected a requirement for an additional $150 million, for which there was no source of funds. While this raised questions as to whether the entire system would be built, the Board of Directors took a firm stand in its policy statement on long-range financing in September, 1966, committing to the entire first-stage system although it was implied that the lower patronage lines of the first stage might be phased in at a later date. This decision provided political leverage: the powerful Assemblyman Knox of Richmond was determined to encourage some legislative assistance to BART to avoid Richmond being phased in after completion of the rest of the system. Nonetheless, the Board's statement indicated it would seek additional sources of funds, even if it required going to the Legislature to increase the permissible level of bonding to 20% of the District's assessed value and seeking an additional bond issue from the public. It was generally agreed that this course was both undesirable and would not be supported by local legislators.

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[1] Ibid.

A number of sources of funding were being explored. BARTD considered it essential to have a guaranteed source of funding to finish the remainder of the system. Without a guaranteed source of funding for the remaining $150 million, BARTD refused to enter into construction or equipment contracts for which it could not pay.

At that time, it was still presumed that rolling stock would be purchased with revenue bonds. While the contract for transit cars had been scheduled to be bid in 1968, it seemed unlikely that any market for revenue bonds would exist when completion of the system itself was in doubt. This presumption that revenues would exceed expenses on operations persisted, despite the existence of memoranda to the file of the Joint Venture -- written by an engineer responsible for the initial revenue forecasts -- that the assumptions were no longer valid. No action was taken on these memoranda.

The federal government was one source of funding which was being pursued successfully by the General Manager. The first assistance to a mass rapid transit system in the country's history was received by BARTD as a result of advocacy by B. R. Stokes, members of the Board of Directors, and the California Congressional delegation. The Federal Housing and Home Finance Agency (HHFA), predecessor of the Department of Housing and Urban Development, provided the first support to BART from its small transportation assistance office. This federal support preceded even the Urban Mass Transportation Act of 1964. Although limited continuing federal assistance of BARTD had been promised informally, the federal government was not willing to pay for the basic system. Thus, BARTD needed to look elsewhere, although the federal government proved a regular source for specific project support. The key decision related to federal funds was not so much linked to funds or their uses as it was to pursuing a federal source of support. During the first ten years of its existence, BART received approximately $250 million of federal assistance from the HHFA, the Department of Housing and Urban Development (HUD), the Department of Transportation (DOT), the Law Enforcement Assistance Administration (LEAA), and the Department of Justice.

To complete the basic system, BARTD was forced to look for either a state subsidy or local taxes. The possibility of a state subsidy was enhanced at this time, since Los Angeles' political leaders also were searching for a way to help finance their proposed Southern California Rapid Transit System. Thus, Southern California support might be expected in the Legislature. On the other hand, Governor Ronald Reagan's new administration had just taken office, based on a platform of a substantial re-reduction in the budget.

BARTD began a campaign to gain additional tax support during the 1967 legislative session. A bill was introduced in the Assembly to increase the motor vehicle in-lieu tax[1] by ½% as a statewide transit subsidy program. This would have brought an estimated $5.5 million to BARTD. Simultaneously, a bill was introduced to repeal the sales tax exemption on gasoline, with the revenue to be provided as a transit subsidy. BARTD would have received approximately $15 million annually under this scheme. While both bills passed the Assembly by small margins, they were defeated in the Senate by rural legislators.

The Senate, on the other hand, approved a bill to increase bridge tolls to subsidize transit, but this measure was defeated in the Assembly. The Administration did not take a position on any of these bills. Thus, although BARTD maintained an extremely active presence in Sacramento, the 1967 legislative session passed with no relief. BARTD continued construction, but put no new contracts out to bid unless sufficient resources were available to pay the entire sum of the contract and the specific work were a discrete element of a possible truncated system.

BARTD quickly recognized the fragile nature of the coalition it needed in the Legislature, one which would transcend both the urban-rural dichotomy and the highway-transit polarization.

The Governor opposed raising property taxes for any purpose, although he recognized the need for emergency legislation for local transit district financing. Whatever the source, however, his position was to exempt rural counties from the tax so their legislators would not oppose it. It appeared that the Administration would support emergency legislation in the 1968 legislative session.

Entering the 1968 legislative season, the financing dispute essentially reverted to one between proponents of subsidies to be drawn from motorists and those who favored taxation of the general public. Increased auto in-lieu taxes, increased tolls on the Bay bridges, increases in auto license fees, and diversion from regular highway funds comprised the alternative subsidies from motorists, although the last was never seriously considered. In fact, diversion from regular highway funds would have required a revision of the Constitution.

With property tax increases ruled out by the Governor's opposition, the instruments of general taxation which were considered rapidly narrowed to an increase in the sales tax within the District. In February, 1968, even the San Francisco Chamber of Commerce recommended a 1/2% increase in the sales tax in San Francisco, Alameda, and Contra Costa counties. Bay Area legislators, however, universally opposed a sales tax increase

[1]The automobile in-lieu tax in California is an automobile tax paid in-lieu of the property tax on motor vehicles.

because of local opposition to such a visible tax and because it had originally been intended for use as aid to education or the reduction of local property taxes. Assemblymen Brown and Burton of San Francisco were particularly adamant in their spearheading the fight against the sales tax.

In March, 1968, Governor Reagan indicated his preference. He supported the sales tax, to some extent because it was not necessary to take it to the voters; it would take effect unless the respective Boards of Supervisors provided alternate sources of revenue. Simultaneously, he commented that he would not approve any general statewide tax whose purpose was merely to aid urban transit. From this point on, BARTD's supporters narrowed their alternatives to taxes with a regional application.

By this time, there was considerable concern among Bay Area political leaders, both local and legislative, over the financial crisis at BARTD. After caucusing under the guidance of Mayor Alioto of San Francisco, a proposal was put forth to support BART through a combination of a flat increase in the in-lieu tax and a $0.10 increase in Bay bridge tolls. While it was reported that William Knowland, a former U.S. Senator and publisher of the Oakland Tribune, favored this approach -- hence, might be able to convince the Governor -- there still was considerable dissension among a small number of local legislators. Senator George Miller, the powerful Democrat from Contra Costa County, had stated publicly that he would support only a bridge toll increase and opposed all other forms of subsidy. Conversely, Assemblyman Robert Crown, Chairman of the Assembly Ways and Means Committee and representing Alameda, focused his support exclusively on the in-lieu tax.

During the next two legislative sessions, supplmentary financing of BART was delayed as legislators sought a method of taxation which would be acceptable to their constituents. The argument as to whether BART ought to gain further funding did not frequently surface. The form of the refinancing was the issue. Not only was it an issue of highway-related subsidy versus general subsidy; but within the highway faction, there were those who favored bridge tolls over in-lieu taxes. The in-lieu tax had the appearance of being part of the highway fund which, if once tapped, would become vulnerable to further diversion. Thus, even highway-oriented legislators might favor bridge toll increases over in-lieu taxes.

Meanwhile, the sales tax idea was largely unacceptable to local politicians.

Any legislation which diverted motor vehicle license fee revenues was treated as a raid on the highway fund by highway-oriented legislators, led by the venerable Senator Randolph Collier, Chairman of the Senate Transportation Committee. Thus, in 1968, just such a bill occasioned not only Collier's reaction of bottling the bill forever in his committee, but brought forth a strong statement from the State Highway Commission opposing the use of highway funds for BART. The Commission even took the step of deferring payment to BARTD of some $3 million owed BARTD for joint construction, at least until action had been concluded on the diversion of the motor vehicle license fee bill, introduced by Assemblyman Mulford. Opposition also was mustered from the State Chamber of Commerce, the California State Automobile Association, the Automobile Club of Southern California, the Motor Car Dealers Association, and the Highway Users Conference. Thus, the "highway lobby" successfully deterred the use of license fees.

During the 1968 legislative session, bridge toll bills had been introduced in both the Assembly and the Senate. The Senate approved the bridge tolls bill, although it was opposed by the California State Automobile Association and the California Trucking Association. The Assembly's bridge toll bill was bottled up in Assemblyman Crown's Ways and Means Committee; it eventually reached the floor only to be defeated. This occurred in the last days of the session, eliminating the possibility that the regular session of the Legislature would provide BARTD financing from highway-related funds. Senator Collier, perhaps in an attempt to defer diversion of highway funds, introduced a sales tax bill. The collier measure was opposed, however, by the Supervisors of all three counties. It was supported by the California State Automobile Association.

Although the Governor was willing to consider BARTD financing in special session, he would do so only if clear support existed for a compromise proposal which included an increase in the in-lieu tax as well as the sales tax. Lukewarm bi-partisan support welcomed this compromise; the San Francisco Board of Supervisors, however, dampened the proposal's prospects by voting 10 to 0 against the sales tax increase.

Despite rejection of his compromise proposal, the Governor bowed to legislative pressure and allowed consideration of BARTD financing in a special session following the regular 1968 legislative session. Governor Reagan opposed the bridge tolls approach, to some extent because he did not want to divert bridge tolls which might be used to finance a Southern

Crossing. A bi-partisan caucus of Bay Area legislators, however, voted 12 to 2 in favor of bridge toll increases, altering the attitude of Assemblyman Mulford, Chairman of the Republican caucus, who now stated he was in favor of bridge toll increases. The Assembly, by a narrow majority, approved a bridge tolls bill. Since the bill already had passed the Senate in the regular session, it appeared that BARTD might gain its financing during that special session.

What was not foreseen, however, was the impact of considering the bridge toll bill in the Senate without the specter of an alternative bill diverting gas taxes or auto license fees before the Senate. Support for the bridge toll bill was only firm as far as some Senators were concerned so long as it appeared the better alternative over diversion of other highway related funds. Thus, in the special session, the majority deserted. The Senate could not muster a majority for the bridge toll increase in support of BARTD during the special session, although it had passed it during the regular session. The Legislature adjourned its special session without action for BARTD. A sense of desperation loomed at BARTD. It had sought support in three sessions and failed. The District stopped all construction.

At this point, local Bay Area legislators realized that the necessity to continue work on BART required acceding to the sales tax proposal. Reluctantly, a group of Bay Area legislators acknowledged that they would not stand in the way of a sales tax bill if it were the only successful financing method. Mayor Alioto also supported it if there were no other way, as did the BARTD Board of Directors. Hence, the 1969 session began with a 1/2% regional sales tax measure in support of BART being introduced in both houses. On April 8, 1969, after passing both houses, the bill was signed by the Governor into law, providing for a tax to go into effect in January, 1970 in the three counties.

This bill was passed in defiance of the almost unanimous view among local political leaders in the Bay Area that sales taxes were not the best way to finance BARTD. An opinion poll taken in February, 1969 confirmed the representation of the politicians: 53% of the public favored the bridge tolls approach, while only 34% endorsed the sales tax increase.[1]

Highway interests had prevailed in forestalling the diversion of highway-related funds to subsidizing rapid transit systems in the cities. Concurrently, the defeat of statewide subsidy bills in the 1967 legislative session signaled a victory for

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[1]Frank C. Colcord, Jr., "Urban Transportation Decision Making: San Francisco," MIT, May, 1971.

rural legislators as well as the highway interests, identifying at that time that there was little political interest in the state acquiring a role in providing public transportation as a public service. Eventually, both sources of opposition would be overcome to permit the state to subsidize transit, though not specifically BARTD. Nonetheless, the identification of effective interest groups in opposition to BART was clear.

E. Formulation of the Fare Schedule

From the earliest estimates in the 1956 "Regional Rapid Transit" report, patronage, at a fare which would not exceed the cost of automobile travel, was projected at a level which would generate a surplus of operating revenues. In the face of little evidence in other older, conventional transit systems, the consultants would state: "Our basic forecast for the first stage operation is that revenues will be adequate to defray operating expenses as well as interest and amortization of the costs of rapid transit vehicles."[1] The first stage, at that time, however, included five counties and 123 miles of track.

This judgment was perpetuated in the later engineering studies, leading to codification in the BART legislation itself. The BART Act made specific mention of fares and their assigned rates:

> "Insofar as practicable, such rates shall be fixed so as to result in revenue which will:
>
> (a) pay the operating expenses of the District;
>
> (b) provide repairs, maintenance, and depreciation of works owned or operated by the District;
>
> (c) provide for the purchase, lease, or acquisition of obligations incurred by the District for the acquisition of rolling stock; and
>
> (d) after making any current allocation of funds required for the foregoing purposes, and by the terms of an indebtedness incurred after Article 6 (commencing with Section 29240) and 7 (commencing with Section 29250) of Chapter 8 of this part, provide funds for any purpose the Board deems necessary and desirable to carry out the purpose of this part."

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[1] Regional Rapid Transit, PBHM, page 3.

BART's mandate was to operate out of the fare box.

In SRI's Report to the Legislature on the organization and financing of the rapid transit district, the consultant cited five other systems: Chicago, New York, Cleveland, Boston, and Toronto. In each case, total expense per passenger exceeded the average fare. Even these negative observations failed to deter the optimism at BART. In the Bay Area, the totally new system, as perceived, was "certain" to generate revenues in excess of expenses. A sine qua non of the attractive modern transit concept was that it would encourage a substantial modal split from automobiles, and, with its highly automated mode, could move people at a lower cost than conventional systems. Thus, reasonable fares, lower than the cost of competing, would generate net revenues.

The Composite Report sought a fare range of $0.25 to $1.00. This fare structure was perceived as an optimal structure to maximize patronage through pricing BART competitively with other modes, without incurring deficit operations. This fare structure, however, was treated as the fixed prices of transit so frequently are: while the expenses of providing transit are inflated annually, the public is loathe to accept a comparable increase in the price of transit, particularly since step increases yield large percentage increases. The $0.25 to $1.00 fare range cited in the Composite Report, if increased according to the rate of cost inflation experienced in the transit industry, would have reached a range of $0.36 to $1.45 by 1970. The costs of travel necessarily increased. The objective of meeting expenses through fare box revenue was unchanged, but an inflationary squeeze affected the capability of the District to meet its objectives.

The first thorough study of the potential fare structure was conducted in 1971 by the BARTD staff. The "BART Interstation Fare Schedule" report was motivated by the need to give IBM a fare structure to incorporate into the fare collection equipment. A contractual deadline for BARTD's decision established the timing of the fare schedule's review.

Other than the stipulation of the Act's mandate -- to provide for fares which meet expenses -- there were few limiting considerations in the formulation of a fare schedule. The other constraints were all determined by the fare collection equipment, which was incapable of distinguishing between people; thus, the fare equipment could not explicitly treat special discount fares. Furthermore, variable peak hour pricing was not possible without reprogramming fare collection equipment. Finally, cash fares could be deposited only in amounts of $0.25, $0.30, or $0.35, establishing the parameters for minimum fares.

With these technical restrictions, the staff proceeded to evaluate thirty-three specific fare schedules, within four different structures: a flat fare, a mileage fare, a competitive fare, and a multi-purpose fare. Among the fare schedules studied were those included in the Composite Report and in the Northern California Transit Demonstration Program. The fare schedule which emerged as most appropriate was similar in structure to that recommended in the Composite Report: a $0.30 base fare plus a mileage factor. This fare structure was considered superior to the alternatives tested for three important reasons: (1) this structure did as well or better than any of the tested alternatives in achieving both high levels of patronage and revenue for a given average price; (2) this structure would appear to appeal best to the public's perception of equity; and (3) this structure was most similar to those suggested in the Composite Report and the NCTDP report. Thus, in some measure, it already had withstood public scrutiny.

According to Lawrence D. Dahms, then Director of Research and later Acting General Manager, the staff recommendations were not restricted by the Composite Report fare levels. An overriding concern was to develop a fare structure which would assure favorable patronage response relative to the fares of A.C. Transit. The Board was equally concerned with the adverse impact higher fares might have on patronage. This concern was reinforced by the Board's general acceptance of an early objective of BART, i.e., to move large numbers of travelers inexpensively in competition with other modes of travel. Nonetheless, Dahms acknowledges that the BART average fare, as recommended and as adopted, is comparatively high by industry standards.[1]

The recommendations of the staff were for a fare schedule which included a $0.30 base fare plus $0.05 per mile for 4 to 10 miles, $0.04 per mile for 10 to 15 miles, and $0.03 for distances in excess of 15 miles. Because the average mileage factor was $0.04, it was termed the 30 + 4.

In fact, considerable debate occurred within the staff of BARTD on the appropriate fare schedule to recommend to the Board of Directors. The so-called "30 + 4" fare schedule was recommended despite the BARTD Office of Research's opinion that 30 + 3 would be the most appropriate schedule for meeting initial operating expenses and encouraging patronage. The desire to attract initial patronage was high; some consideration was given by the staff to proposing free fares for the first month or two.[2]

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[1] McDonald & Smart, Inc. interview with Lawrence D. Dahms, Acting General Manager, BARTD.

[2] McDonald & Smart, Inc. interview with Keith Bernard, Director of Marketing and Research, BARTD.

The 30 + 4 schedule was recommended to the Board because the staff recognized the Board would opt for the lowest possible fare which would meet revenue requirements.[1] Given the recommendation of the 30 + 4 structure, the 30 + 3 was the next most acceptable level of fares. The choice between the two fare schedules rested with the judgment as to how soon the Board of Directors wished to face the probability of increasing fares. The 30 + 3 fare schedule revenue prediction was considered insufficient to stave off a fare increase in 2 years' time. The longevity of the 30 + 4 schedule was greater.

The fare determination in 1971, while still dependent upon the concept of fare box revenue meeting expenses, was merely an administrative recommendation. The Board unanimously approved the 30 + 3 structure for meeting initial equipment installation requirements. General concern was expressed, however, over the high costs on the Richmond line, compared with competing transit, and the undesirability of high rates which might discourage patronage. The fare structure was returned to the staff for revision.

Ultimately, a speed differential was added to the structure, a refinement which reduced the fare of the Richmond line.

The speed differential was essential to bring such lines as the Richmond line into competition with other modes. This feature of the fare structure recognizes the value of time saved. By comparing the scheduled speed for each station-to-station trip with the system's average speed, the advantage particular routes of the system have over the system as a whole are determined. If the trains operate at a higher than average speed on a given route, the value of the time saved is evaluated at $0.02 per minute. On the other hand, if the route is normally traveled with trains operating more slowly than the average speed, the fare structure reflects $0.02 less per minute of the time disadvantage. Once this new schedule was established, with no fare greater than $1.25, a unanimous vote of approval was given it by the Board of Directors.

The decisions which were involved represented the dichotomy of interests present in many of BARTD's deliberations and decisions. The political body, the Board of Directors, wanted the lowest possible responsible fare to encourage public acceptability of the new system and to encourage patronage. Conversely, the staff was constrained by prior commitments on the pricing mandate of the District, i.e., the fare structure was expected to generate sufficient revenue to cover operating expenses.

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[1] McDonald & Smart, Inc. interview with Keith Bernard, Director of Marketing and Research, BARTD.

Fare revenue has not covered operating expenses. A number of factors influence this shortcoming. Naturally the inflation of operating expenses was unforeseen. Also, the cost estimates might have been suspect since they were premised upon optimistic staffing complements. Further, when the District accepted the inadequacy of operating revenues for meeting operating expenses, which did not occur until 1974, reasons were cited such as the impact of reduced fares for senior citizens, youth, and the disabled as well as the reduced patronage resulting from curtailed service. Thus, it has been stated that operations on less than a 7-day, 20-hour schedule will not result in the full predicted and stabilized revenues and precludes the full potential of the system from being realized.

These reasons do not override the absence of vocal professional questioning of the assumptions or analyses which resulted in the fare schedule in 1971-72. While such prominent financial advisors as Alan K. Browne, then Chairman of the Advisory Committee on Financing, cautioned against the reasonableness of an assumption of revenue exceeding expense, little attention was focused on this criticism.

F. Organization of the District and its Staff

1. The Choice of Political Organization

Organizational and staffing requirements of a regional political entity responsible for the implementation of an interurban rapid transit system were alluded to as early as the Commission's preliminary report in January, 1953. At that time, it was recommended that the type of organizational structure necessary for carrying on the construction and subsequent operation of rapid transit facilities, as well as the various methods of financing the project, should be investigated simultaneously with preparing preliminary plans and financial analysis of the first stage of construction.

These early deliberations of the Commission had not yet established the political nature of the entity which would be responsible for a regional transit system. The sole comment on the nature of that entity in the Commission's report concluded that the San Francisco Bay Area Metropolitan District Act, Chapter 1239 of the Statutes of 1949, did not adequately embody the features of an implementable mandate. The early act, after some study, proved to be cumbersome in its mechanics of setting up a rapid transit

district, involving "many difficult and time-consuming negotiations between the various governmental bodies, elections in many political subdivisions, and other procedures inherently difficult of accomplishment." The 1953 study did append a draft of legislation -- the "Transit Authority Act" -- which provided a better basis for the establishment of a political entity responsible for rapid transit.

Ultimately, the evaluation of an appropriate political entity and organization for implementing rapid transit in the Bay Area was conducted ahead of the schedule proposed in the 1953 report to the Legislature. In November, 1953, a contract was negotiated for the engineering study which would formulate a coordinated rapid transit plan and program, including the presentation of planning and engineering studies, adequate to serve the needs of the nine Bay Area counties for the foreseeable future. This report would be transmitted to members of the Legislature in January, 1956. In November, 1954, the Commission retained Stanford Research Institute to prepare a study and report on the practicable means of financing the capital costs of the Regional Rapid Transit Plan and making recommendations on the type of agency which should be set up to construct and operate the proposed rapid transit system.

The Stanford Research Institute report, "Organizational and Financial Aspects of the Proposed San Francisco Bay Area Rapid Transit System," recommended that some form of regional organization for transit ownership and operation be responsible for managing, with optimal dispatch, the areawide problems associated with regional transit. The recommendation followed closely upon the engineering report's recommendation.

Furthermore, since substantial public support was recognized as essential to success of the rapid transit plans, private ownership of the system was considered infeasible.

Public responsibility for areawide transit could be carried out either by a regional authority or by a regional special district. While an authority clearly had the advantage of fewer political constraints on its freedom of action in controlling a transit program, an authority is legally confined to revenue bonds for capital funds (although the bonds could be issued without voter approval). As a non-elective political creature the authority-type of organization had the disadvantage of being beyond the direct reach of local voters; further, it was a far less familiar political entity in California than the district form of government. Nevertheless, the weightiest argument against this form of implementation was financial: "It could not issue bonds based on the faith and credit of the area, and it would not have the power to raise money by taxation."

The determination of a district form of organization was based on the need for substantial capital funding. Although all alternatives were considered, even the Commission staff was sanguine about the funding levels which would be needed. One advantage of the authority was provided for in the founding legislation of the district, an advantage calculated to sustain the reference of the "visionary" group serving as Commissioners. The BART Board was an appointed, rather than elected Board. While this would be revised in 1974, the District was afforded 17 years of public scrutiny, but only indirect control.

2. The Initial Staff Recommendations

The Commission's staff identified organizational and administrative requirements for the transition from a rapid transit commission to a rapid transit district. While the Commission did not seek to establish the policies the district would follow, it did identify the salient features of existing regional districts within the Bay Area and recommended an outline of major events and the personnel who would need to be hired during the first 3 years after formation of the transit district. Table III-1 illustrates the sequence of events recommended to the district in the Transit Commission's report to the Legislature (December, 1957).

This recommended sequence, although merely an outline of the nature of activities, provided a well-reasoned plan for the events leading to the bond election. Ten of the thirty-two events relate to staffing. In the recommended order, they include: Creation of positions by the Board; Appointment of a Secretary to the Board; Employment of Office Assistants; and Employment of Legal Counsel.

The sequence continues with the appointment of a temporary Director of Public Information. There was no illusion among the Commissioners that rapid transit, at a high price, would be easily accepted by the Bay Area Public. First, the Commission ensured its own strong guidance would be continued and, secondly, explicitly acknowledged the compelling necessity for a public information program. The significance perceived for public information was apparent in the priority placed on filling the position of Director of Public Information even before the employment of a general manager (although employment of a permanent Director of Public Information was not recommended without the eventual general manager's approval). According to this recommended schedule, the appointment of a chief engineer would also follow appointment of the public information post.

TABLE III-1

SUGGESTED SEQUENCE OF EVENTS IN PERIOD FROM ORGANIZATION OF SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT BOARD UNTIL TIME OF BOND ELECTION

		Months From Date of Organization[1]
1.	Organization of board of directors	1
2.	Rules of procedure for board	1- 3
3.	Creation of positions by board	1
4.	Appoint secretary of district	1
5.	Obtain office space and equipment	1
6.	Employ office assistants	1
7.	Prepare first budget	1
8.	Arrange for services of a county treasurer and auditor	1
9.	Arrange to borrow funds for administrative expense, 6-8 months	1
10.	Appoint legal counsel	1
11.	Appoint director of public information (temporary or counsel)	1- 4
12.	Begin program of public information	1- 2
13.	Liaison with transit, planning, and governmental bodies	1-36
14.	Establish temporary employment procedure	1
15.	Employ general manager	1- 5
16.	Arrange for tax levy	4- 5
17.	Employ permanent director of public information	5- 6
18.	Review of transit studies by general manager and board	5- 9
19.	Appoint chief engineer	6- 8
20.	Formulate general approach to rapid transit	6- 9
21.	Coordinate right-of-way provisions with community developments and with transportation and planning agencies	6-36
22.	Conduct economic studies	6-12
23.	Borrow funds on tax anticipation notes to repay loans	7
24.	Conduct engineering studies	9-24; 27-34
25.	Prepare for any needed changes in statute	10-12
26.	Conduct financing studies	20-34
27.	Prepare transit plan and financing plan for submission to county boards of supervisors	22-28
28.	Conduct educational campaign on plans	22-36
29.	Consideration of plans by supervisors; revisions of plans	26-34
30.	Prepare proposition for bond election	32-36
31.	Plan permanent organization for construction period	33-36
32.	Bond election	36

[1]The number 1 indicates that the event is expected to be completed in the first month; 4-5 means that the event is expected to start in the fourth month and to be completed in the fifth month, etc.

Source: "Report to the Legislature of the State of California," San Francisco Bay Area Rapid Transit Commission, December, 1957.

As far as full staffing was concerned, the Commission's recommended schedule called for a plan to staff the organization with permanent employees for the construction period three years from the date of organization.

This plan for organization and staffing the Rapid Transit District actually did not occur until after the bond election in 1962. The other events, however, occurred very close to schedule. The Executive Director of the Commission, Angus M. Cohan, was appointed as Secretary to the District in January, 1958. On February 1, 1958, B.R. Stokes, the urban affairs reporter for the Oakland Tribune, who had become both interested and knowledgeable in rapid transit, was appointed Director of Public Information.

The general manager was not appointed until June of 1958, when John Peirce, the State Director of Finance, assumed the role of general manager. Wallace Kaapcke, of the prestigous law firm Pillsbury, Madison & Sutro, was appointed general counsel, while George Harrington, of Orrick, Harrington, was appointed bond counsel. It was not until February, 1959, however, that a former consultant to Parsons, Brinckerhoff, Hall and Macdonald was appointed chief engineer. While at least three other individuals, including Walter Douglas, were considered for the position of chief engineer, Kenneth M. Hoover, who was not licensed for either civil or structural engineering in California, received the appointment and was to remain at the District during its first five years.

The intent of the first Board of Directors -- a group characterized by a reputation for vision and influence -- was to staff the district with individuals of the highest qualifications. To this extent, the legal counsel and bond counsel were of the highest reputations in the San Francisco area.

The selection of John Peirce as the General Manager was influenced by Alan K. Browne, who was Chairman of the BART Commission, which preceded the District Board of Directors. Browne was adamant in his characterization of the managerial requirements for an individual experienced in both government finance and organization. Peirce, about to retire from the highest appointed State office, Director of Finance, became General Manager. While Peirce would be responsible for the District's earliest years, the Board's perception of the characteristics of the General Manager would change by the time of the bond election, when B.R. Stokes would be asked by Chairman Adrian Falk to assume the General Manager's position.

There was no question that the overriding and immediate objective facing this new staff in 1958 was to bring the plan before the voters. Accurate costing of the system, and formulation of a comprehensive financial plan necessitated further engineering. While the general manager and chief engineer administered the continuing engineering, economic, and financing studies, the remainder of the staff focused firmly on the public information role.

3. Consultant as Staff

A key early decision which was not reversed later, after the bond election, was that of retaining an extremely small core staff and relying upon professional expertise of consultants. This staff/consultant imbalance -- in technical experience as well as in size -- led to a situation in which the consultants largely ended up monitoring themselves. While the expertise needed for planning and engineering a regional rapid transit system was beyond the ability of a public agency to acquire temporarily in-house, the absence of even a germinal in-house engineering staff to rigorously review consultant recommendations permitted the consultant to reinforce the trends of his own thinking quite independently of the client. According to Stokes, there was virtually no division, conceptually, between "staff" and consultant. The consultant was, in fact, perceived as staff. The danger is that alternatives are foreclosed when it is the consultant as "staff" who evaluates the consultants' recommendations.

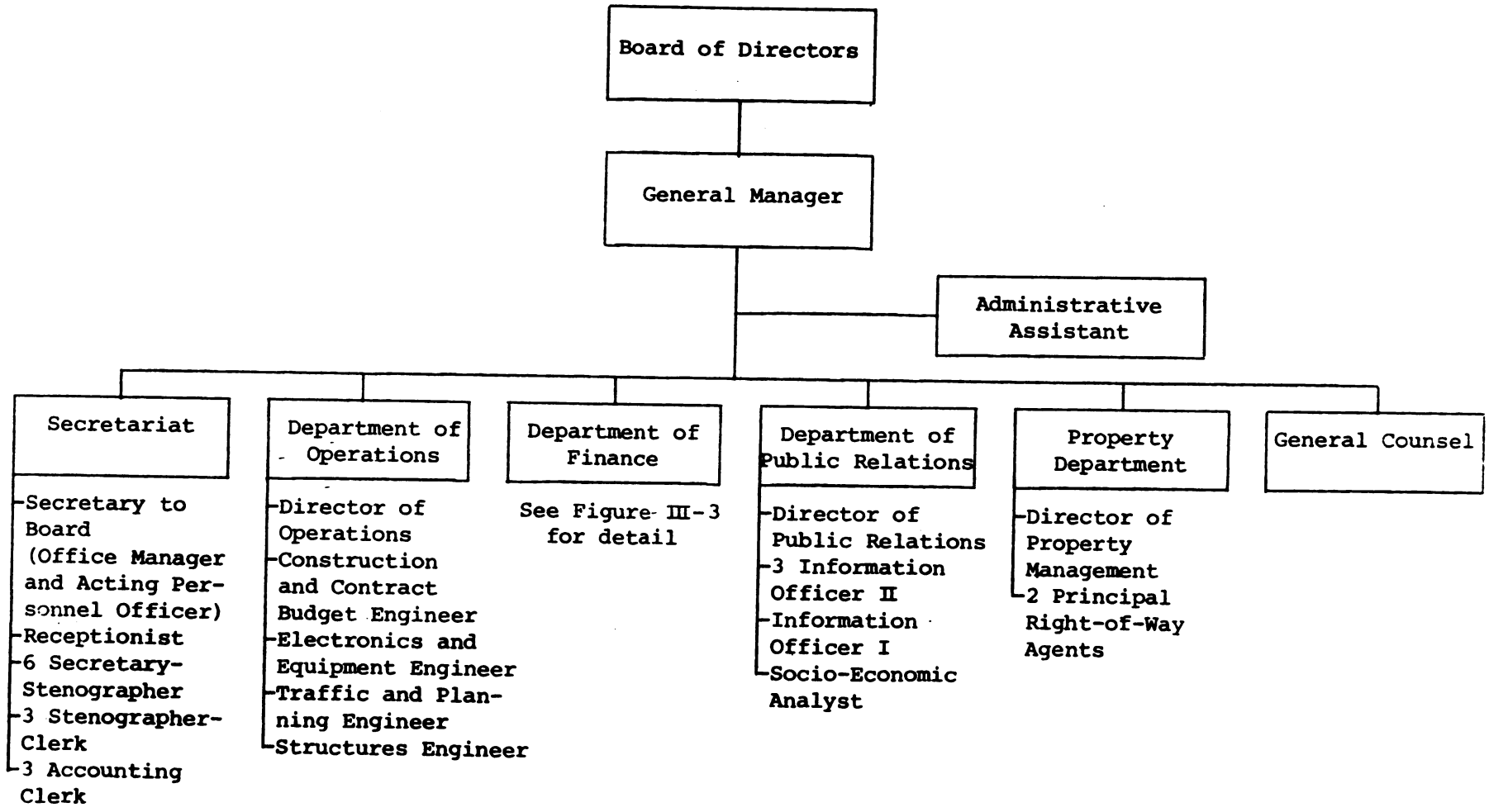
4. Staffing for Implementation

With total attention focused on the bond election, and without the mandate afforded by that vote, the District was unable to staff for implementation -- final design, construction, and operation. Immediately following the election, a taxpayer's suit prevented the District from further hiring. Finally, with resolution of the suit, in mid-1963, a well-known public administration consultant was hired to develop a staffing plan.

The details of organization and staffing proposed in a report (Griffenhagen & Kroeger were hired to develop and organizational structure) are illustrated in Figures III-2 and III-3. The recommendations were conventional in nature, based upon the premise that the District staff should merely <u>administer</u> the construction process. <u>Operational control</u> of that process, by implication, would be the responsibility of the Joint Venture. The District was encouraged to adopt a policy of contracting for the major technical and related professional

FIGURE III- 2

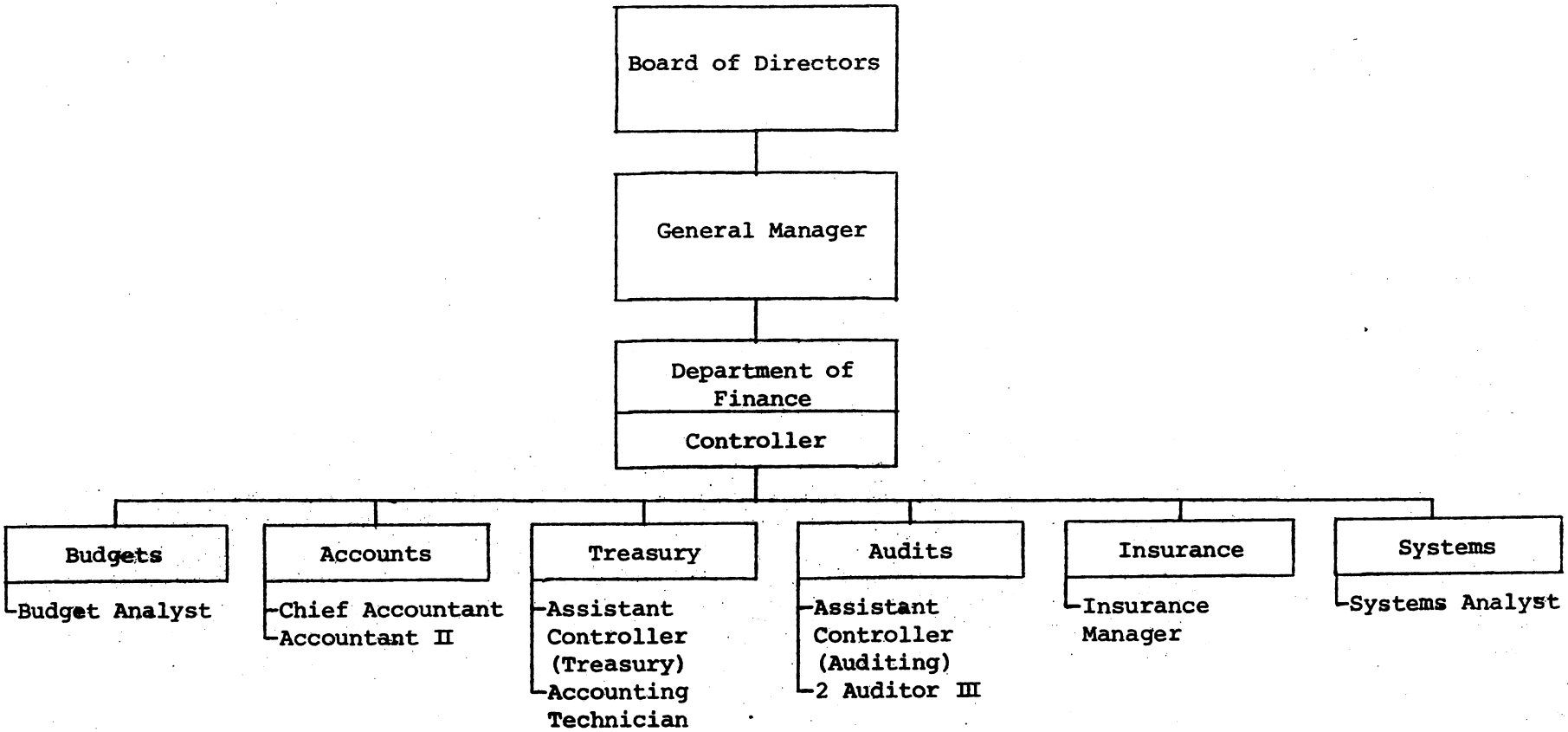
SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT:
PROPOSED ORGANIZATION AND STAFFING



Source: "Organization and Staffing San Francisco Bay Area Rapid Transit District," Griffenhagen-Kroeger, Inc., September, 1963.

FIGURE III-3

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT:
PROPOSED ORGANIZATION, DEPARTMENT OF FINANCE



Source: "Organization and Staffing San Francisco Bay Area Rapid Transit District," Griffenhagen-Kroeger, Inc., September, 1963.

services. Stokes, who became general manager in 1963, felt bound by these staffing recommendations; thus, he avoided developing parallel capabilities until cost estimates and construction schedules appeared to go awry in 1965.[1] In the interim, the Joint Venture and the District staff worked as a single team, a relationship which was questioned as early as the taxpayers suit in 1963, when a fiduciary relationship was alleged.

The Griffenhagen-Kroeger report, which recommended one engineer and only two real estate right-of-way acquisition people for $100 million worth of acquisition, naturally resulted in decisions being made by consultants. Eventually, by 1967 as more contracts were being brought to bid, the engineering capability of the district increased to 75. Nonetheless, the lack of initial staff with which to evaluate consultant products had a substantial effect on the amount of control wielded by the District itself. Slowly, without a clear policy determination on staff size, the District's table of organization grew to fill identified needs. Table III-4 summarizes this growth. One problem with the manner of selection of many of the staff was that the decisional inertia of the Joint Venture was not necessarily challenged by the staff, since the staff was frequently recruited from the Joint Venture, and made responsible for critically implementing a system they had designed and managed.

The evolution of the staff, as it recognized the danger of vesting virtually all technical capability in the Joint Venture, is reflected in Figures III-IV through III-VII. These Figures represent the authorized staffing plans for 1964 through 1966. In 1964, the staff emphasis was on real estate and finance, with development and operations consisting of only 19 staff members. By the following years, the Director of Development and Operations had changed, although the staff complement remained the same. Meanwhile, the Real Estate and Property Department increased from 31 employees to 45, reflecting the increased workload of property acquisition. The Department of Finance also increased in size slightly.

In 1965, D.G. Hammond, previously responsible for overseeing structural engineering, became Director of the Department of Development and Operations. Hammond recognized the requirements of critically reviewing the controlling the implementation of the system. Under his aegis, the staff requested an

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[1] McDonald & Smart, Inc. interview with B.R. Stokes.

TABLE III-4

BARTD MANPOWER BY YEAR

Date	Total Number of Actual Employees	Public Information	Planning	Political Liaison	Opns	Others[1]
-1-58	8	2	0	0	0	0
-1-59	15	3	0	0	2	0
-1-60	18	5	0	0	3	0
-1-61	19	5	0	0	3	0
-1-62	16	5	0	0	3	0
-1-63	16	5	0	0	3	0
-1-64	71	9	0	1	8	0
-1-65	131	9	0	1	12	7
-1-66	161	8	0	2	10	20
-1-67	223	9	0	3	35	40
-1-68	233	10	0	3	38	42
-1-69	256	10	3	3	50	48
-1-70	352	11	3	4	130	54
-1-71	527	14	9	2	288	52
-1-72	654	17	9	2	413	50

[1] Difference between total and indicated sum.

Source: BART Response to Senator John Nejedly, op.cit.

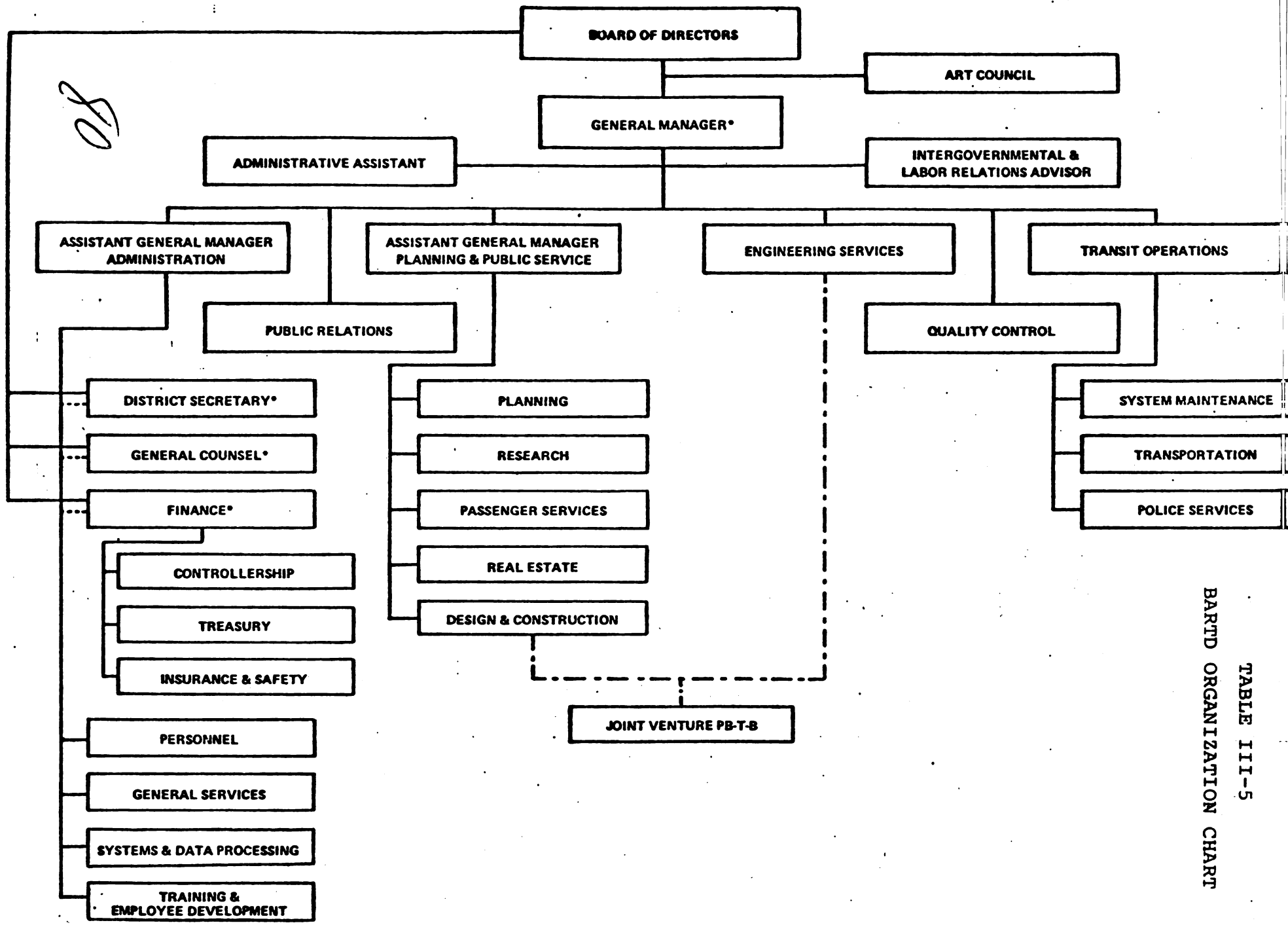
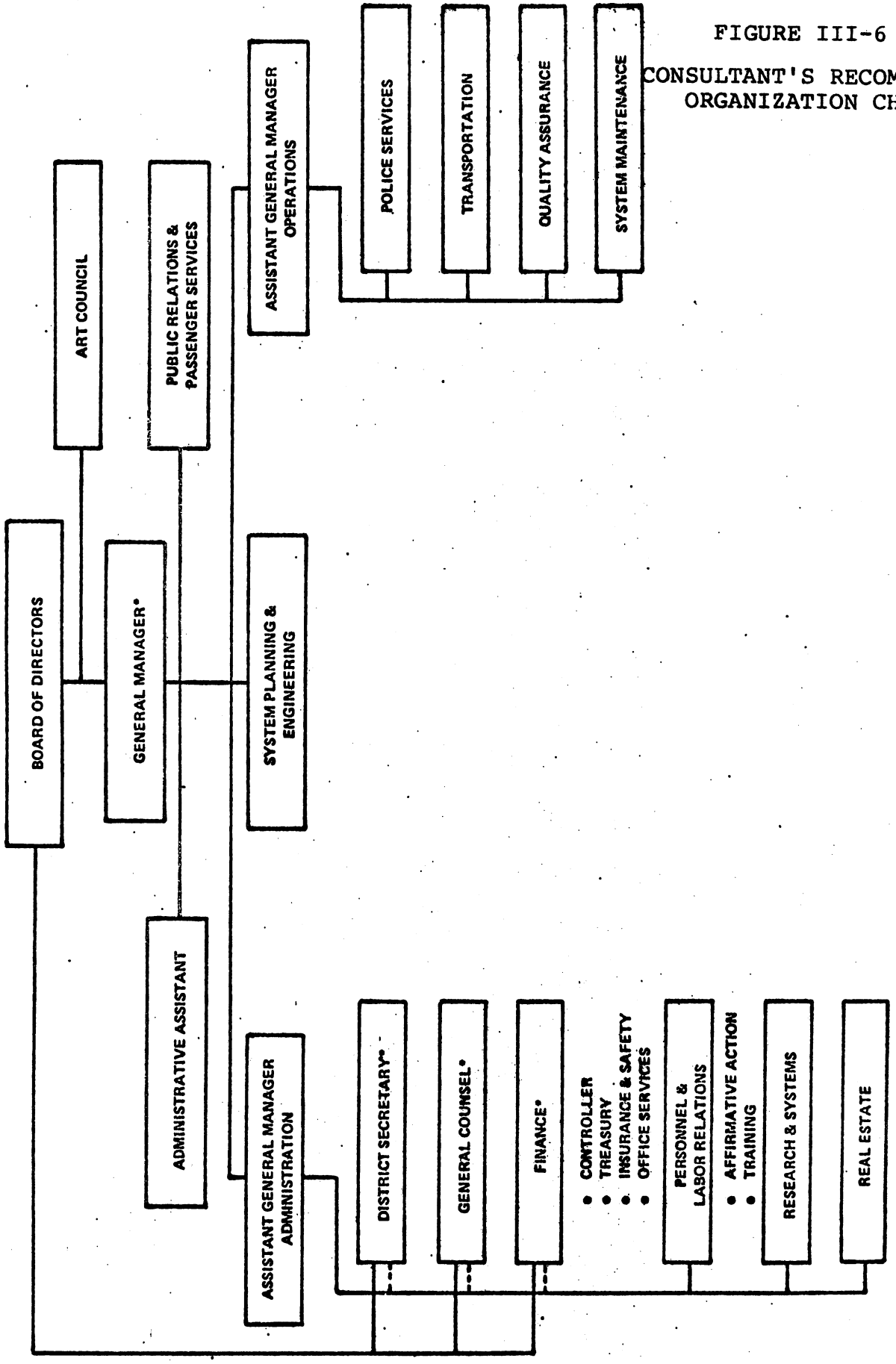


TABLE III-5
BARTD ORGANIZATION CHART

* Board Appointee

FIGURE III-6

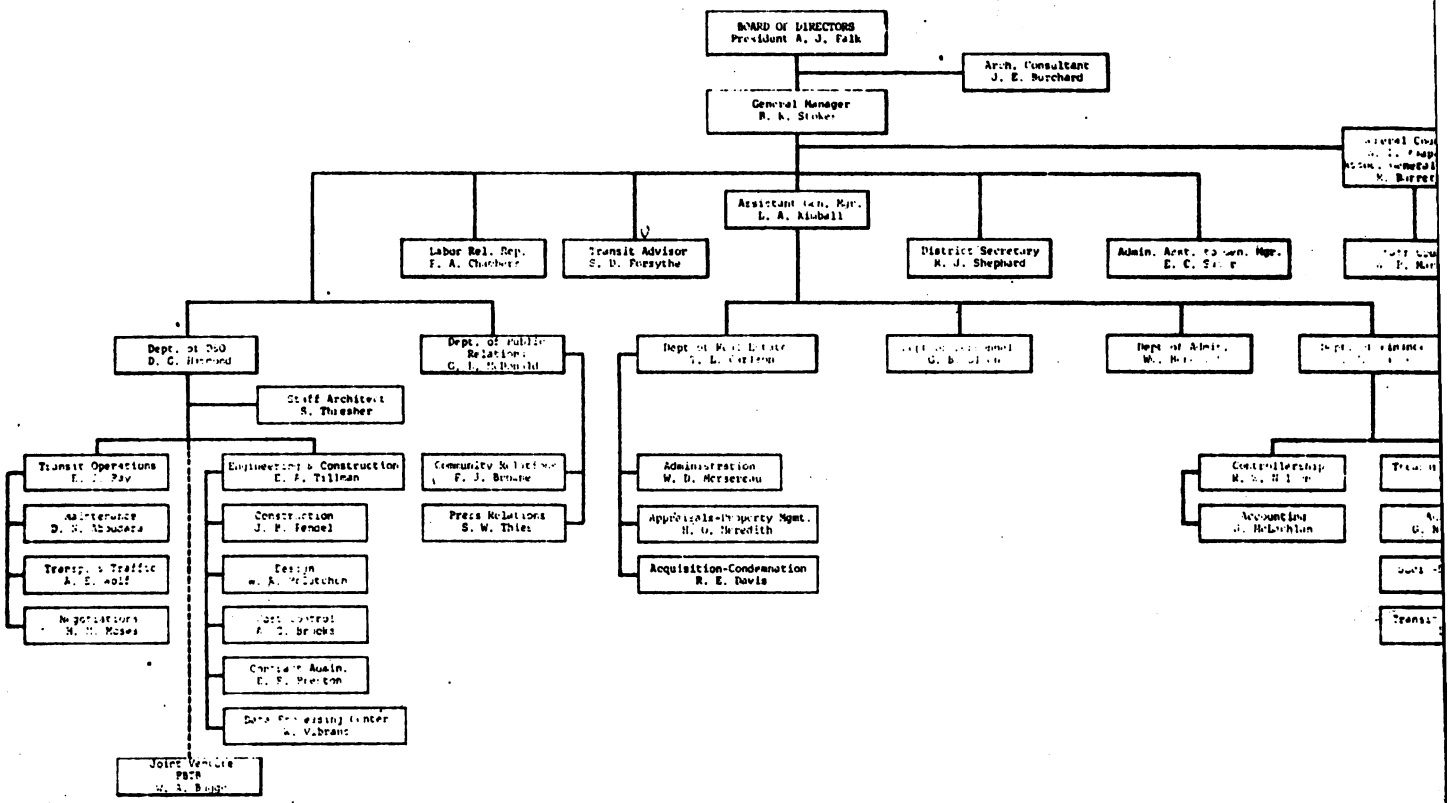
CONSULTANT'S RECOMMENDED ORGANIZATION CHART



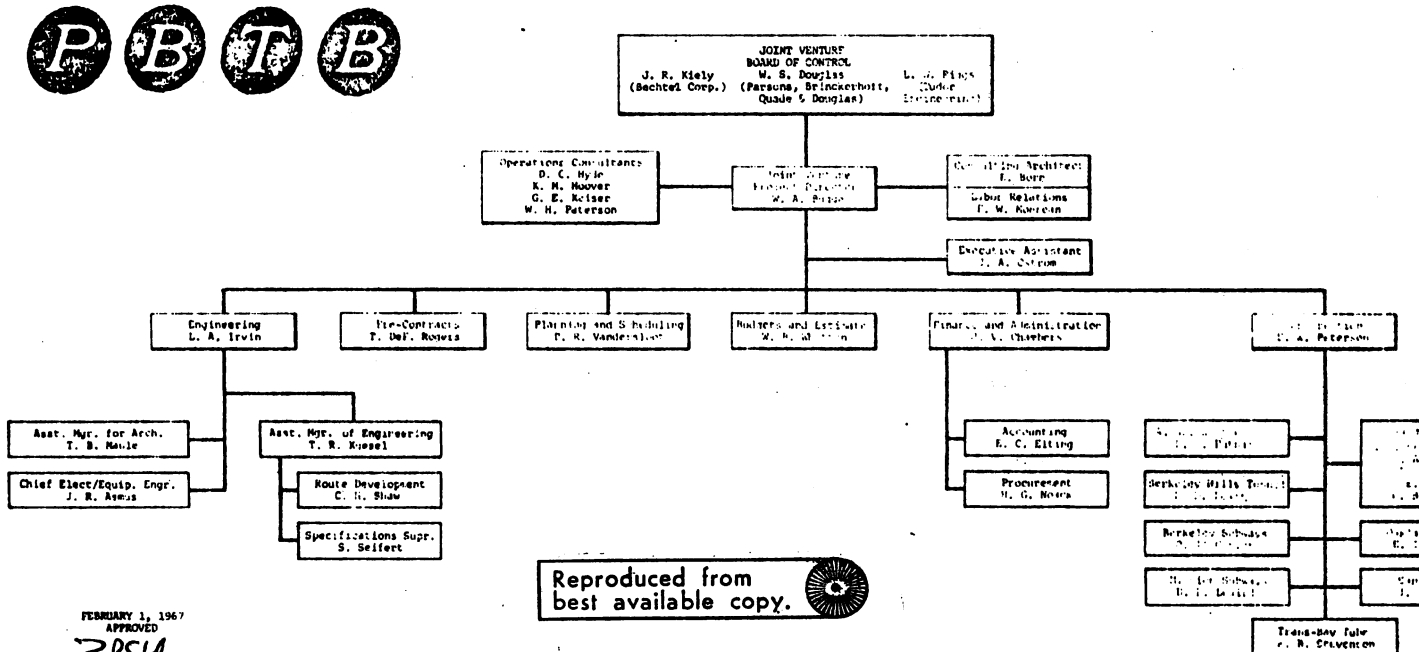
* Board Appointee

FIGURE III-7

BAY AREA RAPID TRANSIT DISTRICT



PARSONS BRINCKERHOFF • TUDOR • BECHTEL



FEBRUARY 1, 1967
APPROVED

R. R. STOKES
GENERAL MANAGER

additional 30 technical professionals to fulfill the control function which was his department's responsibility. This staff augmentation occurred in 1966, at which point a marked shift occurred toward greater staff control of the construction and development progress.

5. The Role of the Board

One organizational consideration which was reviewed in the Griffenhagen-Kroeger report was the role of BARTD's Board of Directors. According to all accounts, the early Board was respected for the stature and vision of each of its members. Although the Board was united in its approach to fulfilling the broad objective, it continued to make a considerable number of administrative decisions affecting the implementation of what, for many of them, might have seemed but a dream years earlier. Since the division of administrative and operational responsibilities between the Board and the general manager was to later haunt the District, it was interesting to note that this early consulting report recommended a clear understanding of the Board's responsibilities vis-a-vis the staff.

The consultant report concluded:

> "This Board, like any Board of Directors, should act as a policy-making body, recognizing the authority and responsibility of an appointed executive to execute that policy. Policy consists of major determinations about what is to be done and setting the general standards according to which it is to be done. Administration is concerned with determining the precise steps and seeing to their execution in accordance with that policy. The Board should neither try to prescribe these administrative steps nor deal directly with any part of the administrative organization, except as the Board acts collectively and transmits its action through the General Manager.
>
> "The Board should properly insist on having full information about what is taking place, but there is a vast difference between being informed and having to act on every detail before it can be undertaken. If on the basis of the information provided, the Board becomes convinced that the administrative organization is not functioning as it intends, the remedy lies not in having the Board scrutinize and control every detail, but in making the necessary changes in the administrative structure or its staff.

"We sense that the present method of operation is based on an assumption by the Board that what it has not delegated to the General Manager is still the authority and responsibility of the Board. We do not so read the statute. It appears to us to define the separate responsibilities of the Board and the General Manager. The point of this discourse is that the separation between policy-making and representation of the public interest on the one hand, and the actual direction and execution of the program in accordance with law and policy on the other hand, should be recognized and observed."

The conclusion of the Board's role in the 1963 report follows:

"We recommend that at an early date the Board and general manager together, with the provisions of the statutes before them, resolve any questions of operating relationships in a way consistent with law and good practice."

This recommendation was to be repeated a full decade later when Arthur D. Little, Inc. was brought in to review the organization and staffing requirements for full revenue service. At that time, it was concluded:

"Each member of the Board is a representative of the public. We believe Board members take their responsibilities seriously, and are generally motivated by the desire to do an excellent job. Over the past months the problems which have confronted BART have caused the Board members to become more and more involved in administrative matters. They have sought to understand, and to solve problems, some of which were administrative in nature.

"This has resulted in a considerable amount of conflict since Board members should not be involved in administrative matters. They have a heavy enough responsibility at the policy level. The enabling legislation of BART makes this policy responsibility quite clear. Article III of Chapter I (28762) states 'the Board of Directors is the legislative body of the District and, consistent with the provisions of this part, shall determine all questions of policy.' It is admittedly difficult to draw a clear line of demarcation between policy and administration. Nevertheless, if the Board becomes too heavily involved in administration, it will be at the expense and neglect of its proper policy responsibilities."

The original legislation for BART (SB 850) established the powers and duties of the General Manager. These included:

(a) To have full charge of the acquisition, construction, maintenance, and operation of the facilities of the district.

(b) To have full charge of the administration of the business affairs of the district. (emphasis added)

(c) To see that all ordinances of the district are enforced.

(d) To administer the personnel system adopted by the board and except for officers appointed by the board to appoint, discipline or remove all officers and employees subject to the rules and regulations adopted by the board and the applicable provisions of this part.

(e) To prepare and submit to the board as soon as practical after the end of each fiscal year a complete report of the finances and administrative activities of the district for the preceding year.

(f) To keep the board advised as to the needs of the district.

(g) To prepare or cause to be prepared all plans and specifications for the construction of the works of the district.

(h) To devote his entire time to the business of the district.

(i) To perform such other and additional duties as the board may require.

(j) To cause to be installed and maintained a system of auditing and accounting which shall completely and at all times show the financial condition of the district.

During the 1974 legislative session, the power of the General Manager "to have full charge of the administration of the business affairs of the district" was amended to state: ". . . subject to direction of the board." While Lawrence D. Dahms, Acting General Manager of the district at that time, considered the change only semantic in nature, because it merely documented

a procedure already within the intent of the law, this would appear to contradict the problem identified in the consultant report which faulted the Board for excessive involvement in administrative matters. Rather than structuring the Board's responsibilities, the new legislative definition of the powers and duties of the General Manager ensure the Board's powers would not be usurped by the General Manager.

6. Organization and Staffing for Full Revenue Service, 1973

A decade after the District's first organizational staffing plan, and subsequent to the introduction of revenue service, the Board of Directors contracted with Arthur D. Little, Inc. to review BARTD's internal staffing plan for full revenue service. The initiative for this study was partially the continuing critical review of BARTD's costs by the Legislative Analyst's office. Additionally, the general manager had long felt the need for such a study. This review of the staffing requirements was seriously constrained by time, but included an evaluation of the staffing requirements of comparable transit organizations elsewhere in the country.

Several conclusions were drawn:

-- The organizational structure of BART had not been rationalized for the transfer of primary functions from planning and construction to operations.

-- As a result of this weakness, the general manager continued to be the single focus for almost all functional responsibilities, with six divisions reporting directly to him. (See Table III-5.)

-- The consultants recommended a consolidation of functional activities under a second level of management which would report to the general manager. (See Figure III-6.)

-- The growth of the staff, due principally to the bureaucratic tendency of each division's perception of its own importance, had resulted in an imbalance in the percentage of staff involved in non-operational aspects rather than operational aspects of the District's functions. This was a natural outgrowth of the primarily administrative and planning functions of the BARTD staff from 1962 through 1971.

-- The role of the general manager should be above the day-to-day operational control of BART. Rather, the general manager should provide direction and leadership and should work closely with the Board. The general manager should be responsible for public relations, board relations, community relations, and long-range planning.

The growth of the District's staff from 16 prior to the bond election to 654 in 1972 occurred in ad hoc response to the inadequacies of the 1963 plan, reinforcing the staff weaknesses, rather than in compliance with that plan.

In the area of staffing for revenue service, decisions are highly relevant to financial requirements. The initial assumptions on revenues exceeding expenses, providing the basis for revenue bonds, were based on a considerably smaller staff with a payroll one-third the present payroll.[1] In 1972, BART estimated it would need 1,412 BART employees for operational activities, including engineering and planning.[2]

The disparity between the number of employees projected in the early planning years and the number of employees which have been required for operations (particularly in the area of maintenance) has been credited with providing a primary cause of deficit operations. "Even if we assumed no inflation and met original patronage projections, the system would still not make it through the fare box for this reason alone," according to Dahms.[3]

This number of employees has adverse impacts on the efficiencies of even a highly automated system. Although only 225 employees will be "driving" the trains, there is a need for 174 station agents. This station presence reflects an early determination that personal service -- solving fare problems and making announcements -- would augment patronage response.

Maintenance of BART's structures, wayside equipment, tracks, stations, rights-of-way, and parking lots calls for nearly 450 employees, twice the number of train operators. This function

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[1]Although the Composite Report did not cite a staffing level, working papers supporting the Composite Report indicate a total of 1,444 employees required to operate an expanded system. Interviews with an engineer responsible for early cost estimates established the manpower level for a three-county system as susbstantially less, although he was unable to recall the total.

[2]Response to Senator Nejedly's Questions Concerning the San Francisco Bay Area Rapid Transit District, BARTD Office of Research, February 3, 1972.

[3]McDonald & Smart, Inc. interview with Lawrence D. Dahms, Acting General Manager, BARTD.

barely exists among bus-oriented transit systems utilizing public rights-of-way. Finally, the maintenance requirements have been considerably higher than predicted, requiring 185 maintenance personnel, many highly specialized, to service the automated system.

One decision with considerable impact on BART's labor costs -- and one with far-reaching implications for all other public transit operators -- was the federal government's formulation of a requirement that a public agency which, with federal funds, competes or replaces a private transit service, must provide precedence in employment to any employee of the private transit sector who is consequently unemployed.[1] The overwhelmingly adverse effect of this stipulation is that it not only provides for giving precedence to any individual laid off because of BART's competition, but it also requires that the former rates of pay and seniority status of that individual be honored by the Public Transit Agency. This has both financial impacts and efficiency impacts.

[1]Section 13(c) of the Urban Mass Transportation Act of 1964.

IV. THE IMPLEMENTATION OF A REGIONAL RAPID TRANSIT PLAN

Many of the most significant decisions associated with BART occurred in its early planning period. Concepts and options were assessed, some were eliminated, and the shape of BART was progressively defined. Indeed, many of the decisions which one would normally associate with final engineering and construction -- whether of the rails or the operating system -- actually were determined prior to the bond election. Hence, this section tends to describe many of the events associated with constructing BART, with few evaluations of the staff deliberations concerning the alternatives available, since the decisions often were made within the Joint Venture, which then posed single recommendations to the BART Board or staff.

Naturally, many minor decisions were made which affected the final BART system and its service levels. Most of these decisions occurred bureaucratically: Joint Venture recommendations on the basis of costs, service expectations, or technology, concurred in by the staff, and passed by the Board, when appropriate.

A. Route Location and Alignment

The plan for a regional rapid transit system was formulated by BART's consultants prior to the bond election. The bond election provided the funding for implementing that plan. Hence, the basic route locations for BART were determined in the early "Regional Rapid Transit" study (1953-1955) and were based on that study's evaluation of the interurban traffic flow existing in the Bay Area. The three criteria for route selection presented in that report were:

-- The regional development studies embodied in the Regional Outline Plan. These studies, conducted by BART engineers, identified the projected pattern of industrial, commercial, residential, and recreational land uses in the Bay Area, thus defining in general terms the basic travel demand corridors which would need to be served by an interurban transit system.

-- The traffic studies and analyses which determined the origin and destination of existing travel in the Bay Area. Travel demand also was projected on the basis of the Regional Outline Plan land uses. This resulted in a forecast of the volumes and patterns of future travel demand.

-- The engineering feasibility studies which, based on the previous two determinations, considered the general travel corridors BART should serve in the context of terrain constraints, construction procedures and costs, utility interferences, and the costs of right-of-way acquisition.

Assessment of the traffic flow, in turn, depended upon origin and destination studies conducted at cordons on the existing highway network in the Bay Area in the spring of 1954. Since these surveys were conducted on interurban routes, it could be expected that the origin/destination surveys would reinforce the observation that the travel demand of the Bay Area was represented by the patterns of highway traffic flow. As a result, the demonstrated travel demand which would dictate the route locations would tend to follow the major highways in the Bay Area. The Regional Outline Plan, which projected the land use patterns of the Bay Area in 1990, further reflected the influence of the highway network, since the highway transportation system already had served to direct growth as well as relate to it. Thus, the corridors which would be served by BART were inevitably parallel to the Bay Area's highway system.

Where BART planning was based on existing land use patterns, this process reinforced existing travel patterns, since land use had naturally been determined by the existing transportation network, and travel demand (including origin and destination) was based on existing land use. Since the objective of BART was to reduce congestion and supplement a regional highway transportation plan, this phenomenon was not totally undesirable. On the other hand, the transportation engineers' role in projecting future land use, and basing a transportation route

structure on those projections, introduced the probability of a self-fulfilling prophecy. Granted, there was virtually no alternative. At the time of the 1953-1955 study, there were virtually no comprehensive land use planning capabilities within the counties or local jurisdictions; thus, the engineers provided that capability.

In two cases, the route location would have a highly influential impact on the land use patterns of the area. The PBHM study identified Walnut Creek and Fremont as areas of potential future growth. Urbanizing land use followed the BART routes into these communities. The apporpriate query is cause or effect?

The route locations as determined in the early study related very frankly to the mandate: BART was to be a rapid, interurban transit system which would improve the mobility of people living in the suburbs to commute to the cities which were identified as three urban centers -- San Francisco, Oakland, and Berkeley. There was no question in the early planners' minds that San Francisco was to be a financial and commercial center, and that its relationship to Oakland and Berkeley was premised on the roles of those cities as a warehousing center and academic center, respectively.[1] Beyond the influence of the basic mandate which the Commission had given to the engineers, there was little substantiated external pressure on route location decisions.

The general location of the BART routes within the three counties which it would eventually serve stemmed from 1954 engineering considerations. While right-of-way acquisition, community interaction, and ultimate engineering studies would determine the precise location within the identified routes, the 1956 Plan's proposed network was barely questioned, even by the engineers, in later stages of engineering and planning. This lack of rigorous reevaluation of route locations may have been inevitable when the same engineering team (augmented 1959-62 by Tudor personnel) conducted each successive stage of route planning. (To some extent, of course, natural travel corridors existed which reasonably precluded consideration of alternatives.

[1]Interview with B.R. Stokes, April 14, 1975.

Later, in the preliminary engineering period prior to the bond election, the District Board members would have greater influence in precise location decisions within the corridors defined in the 1956 report. These influences would be based upon both the personal visions of the Directors and on their sense of political acceptability within their constituency.

1. Grade Separated Right-of-Way

The costs of construction and the availability of right-of-way also had a strong influence on engineering decisions for route location. As a rapid transit system, one basic consideration which governed route alignment was the need for BART to operate over its own grade separated right-of-way. The problems associated with grade separated rights-of-way were dominant engineering considerations in identifying precise route location within generalized service routes. Furthermore, PBHM adopted design objectives relative to the various types of construction which could be used:

> "The design objectives for each are simple: low cost, attractiveness, and unobtrusiveness. Low cost is always predominant and in the public interest; the aesthetics of the rapid transit structures is a major factor in determining general public acceptance of its form and its impact on the value of adjacent properties. These basic objectives are often in conflict, however. The ideal combination of invisible structures at zero cost is impossible, and we must therefore make compromises."[1]

During preliminary engineering, it was considered that a surface alignment would be the most economical. Where possible, the route location sought existing transportation rights-of-way which would provide low cost land acquisition. At-grade alignment was also considered for rural land. Where land costs increased and cross-corridor traffic proliferated, particularly in urban centers, the surface alignment was no longer economically feasible. Furthermore, where a considerable number of grade separated crossings had necessarily to be constructed, the cost of this alignment relative to an aerial structure was no long advantageous.

In major urban centers, the costs of land acquisition and the public cost of removing properties from the tax rolls made surface alignment inappropriate. While aerial structures would be less expensive than subway, even in city streets, frequently

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[1] Regional Rapid Transit, page 53.

there is inadequate space for the anchoring of aerial structures, and the obtrusiveness of an aerial structure on narrow streets in a densely developed area was considered politically infeasible, particularly when its impact could have a detrimental effect on the very real estate values it would be expected to increase.

The aerial structure was considered to be the most advantageous solution when it could be located on wide, no-cost rights-of-way such as public streets and highways or on low-cost private rights-of-way adjacent to or over existing railroads. Elevated structures, however, were considered only for wide streets or rights-of-way, at least 94 feet between property lines. The structure was to be built in the center mall for purposes of safety as well as to reduce the negative impact it might have on the aesthetics of the neighborhood. It was considered essential that the site line with which people observed aerial structures be as long as possible to reduce its obtrusiveness.[1] Furthermore, aerial structures were discouraged where they were perceived as community barriers.

2. Local Participation in Route Location and Alignment Decisions

Although economics and design objectives created definite constraints to the ultimate route location and alignment decisions, BARTD by no means was autocratic in the determination of the final locations. During 1953-1955, PBHM met with the City Councils and Boards of Supervisors of all jurisdictions through which its generalized travel corridors passed. In each case, they met with the staff which, with only a few exceptions, had no planner. These local political bodies were queried as to their perception of the optimal areas of growth within their communities and the most appropriate route for a rapid transit system. While no official resolutions were required at this point, the general demands of the local communities were included in the planning process. Unfortunately, few of the local communities realized the potential of a rapid transit system and, at least in the East Bay, the attitude was frequently that BART, as a railroad, should be down along the Bay with all of the other railroads. (To some degree, this would prove to coincide with the most economical route location.)

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[1] "Regional Rapid Transit," op.cit.

In the preliminary engineering stage, between 1959 and 1962, the interests of the local officials on route location again were well-received by BART planners. At that point, it was politically essential to have resolutions of support from local officials before going before the Boards of Supervisors for approval of plans. Thus, the adequacy of the system for meeting local needs and minimizing disruption to local communities was paramount. Still, at this point, few cities committed effort for serious route location; some officials of local jurisdictions still considered BART to be a fantasy which, while a "good thing," was unlikely to be passed by the electorate.

After passage of the bond issue in 1962, the task before BARTD was to secure agreements with each of the local jurisdictions through which it would pass. With this requirement, it became apparent to local communities that they were not only responsible for rational land use planning in conjunction with BART, but had some leverage in determining BART's impact on the communities. The necessary agreements, after all, covered route locations, station locations, and alignment as well as all other aspects of the relationship between local jurisdictions and BART. As this point, many of the details of construction were open to negotiation. Local shares of expenses, associated highway improvements, grade separations, landscaping, and other aspects associated with construction of a mass transit system were argued. BARTD did not lose sight of the importance of the local agreements and, hence, was reasonably conciliatory in its acceptance of conditions for approval of its plans. BART was extensive in accommodating local requirements despite the fact that initial cost estimates failed to include an allowance for many of the embellishments ultimately provided. The District's policy from the start, however, was to make every effort to accommodate local demand, within financial capability. These demands ranged from a tennis court above the Western Portal in San Francisco to Berkeley's demands that alignment be subterranean rather than aerial. The latter demand, however, involved a substantial cost which BART had not anticipated when the system was costed on an aerial alignment. Thus, as documented elsewhere in this history, BART did not concede.

The District Board, staff, and the Joint Venture leadership, particularly Walter Douglas, were united in their commitment to BART's potential role as a positive contribution to the Bay Area and its communities. BARTD sought to satisfy all reasonable local demands, although there had been no earlier perception of the magnitude these demands would reach. Essentially, BART sought popular acceptance as an aesthetically

pleasing, responsible transit solution to highway congestion and continued this pursuit until the expense of meeting local demands and particularly the inflationary impact the delays associated with community participation had on construction costs became overbearing. At that point, which occurred long after the drawdown of funds exceeded those allocated for community improvements, BARTD became more reluctant to accept costly community imposed changes. Nonetheless, BART was conscious of the political necessity of seeking local agreement even on improvements which fell short of all local demands. Many communities imposed upon BART, in their final negotiations, even the cost of local improvements that would otherwise have been a municipal responsibility.

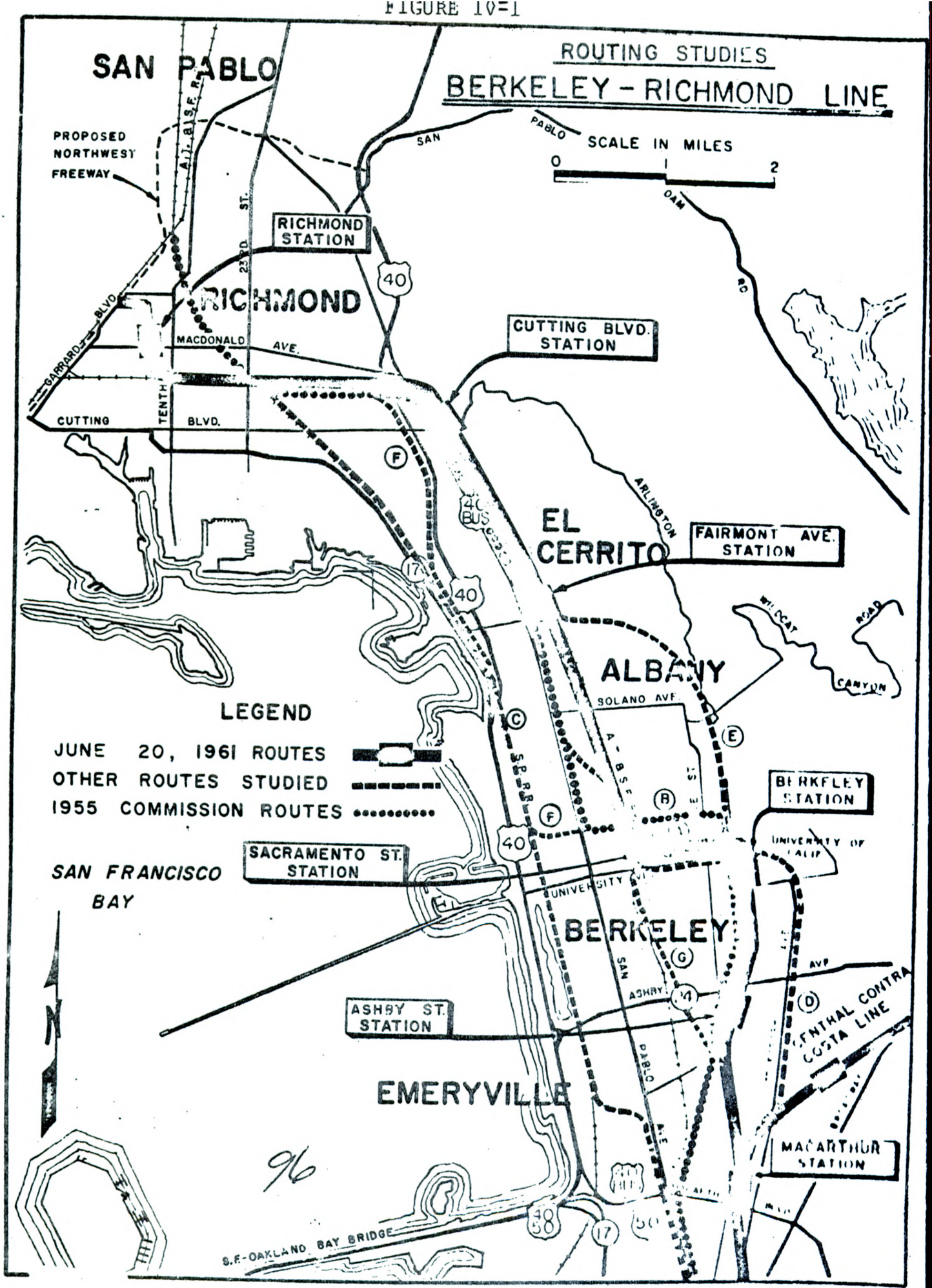
BARTD responded to the need for this participation without having budgeted for its consequences, assuming that the level of detail of the preliminary engineering which communities had accepted sufficiently defined the plan to permit final engineering and construction to begin, unopposed. This assumption proved a costly error, both because of early inadequate financial control and the unanticipated impact of the delays in the construction schedule and costs.

This section will summarize the major determinants of route location and alignment decisions of each line.

a. Berkeley-Richmond Line

The route which was proposed to the Bay Area Rapid Transit District in June of 1961 in PBTB's Engineering Report is illustrated in Figure IV-1. This route represented a considerable amount of engineering effort and took both service to the community and construction costs into account. The proposed line ran westward from MacArthur Station, which is a transfer point to Concord and Daly City, crossed over the MacArthur Freeway and proceeded westerly from the freeway to Grove Street. From there, the line was parallel to Grove Street and Shattuck Avenue. From Ashby Street Station, it continued northward to Derby Street where there would have been a transition from an aerial structure to a subway structure. Subway construction continued through Central Berkeley to the area of Hearst Street, where the line again emerged as aerial structure to the Sacramento Street Station. From there, the alignment curved northwest and generally followed the Atkinson-Topeka & Santa Fe (AT&SF) Railroad right-of-way. The construction consisted of an aerial structure as far as

FIGURE IV-1



the Eastshore Freeway, at which point the construction was to be on an embankment parallel to the railroad tracks.

At this point, the proposed line centered between Fifth and Sixth Streets and entered Richmond station. North of this station, there was to be a storage and maintenance yard; ultimately, additional right-of-way was to be acquired for a northward extension of the line.

b. Alternative Routes

The route described above represented the best combination of factors as they were understood in 1961. These recommendations were made after many other alternative route location studies had been made. The ensuing discussion illustrates the sometimes arbitrary, sometimes careful way in which these route location decisions were made. The route proposed by the BART Commission in 1955 was based on a slightly different set of assumptions than the 1961 locations. At that time, rapid transit was to connect subregional centers with the metropolitan core areas. Thus, a routing which passed through Central Richmond and Central Berkeley and into Oakland appeared to be necessary. It was felt that such a route would help to alleviate congestion between Oakland and Berkeley. This proposed routing is shown as a dotted line on Figure IV-1.

Various problems with the Commission route surfaced at early stages of the planning process. These led to additional study. Alternative routes are shown as dashed lines on Figure IV-1. In brief, the objections centered around alignments which would improve traffic congestion on local streets, but would at the same time not reduce the capacity of major arterials that connected the various communities. Consequently, station locations as well as route alignments were changed to resolve these difficulties and to provide for an alignment which would combine the Berkeley-Richmond and Contra Costa lines into a single approach leading into Central Oakland. Insofar as this latter consideration is concerned, only one street appears conveniently located with respect to both lines; this was Telegraph Avenue. If the Grove-Shafter Freeway alignment, as proposed in the 1961 recommendations, proved to be unworkable, then this alternative approach was considered the next best alternative.

As pointed out elsewhere, low-cost right-of-way acquisition and lowered construction costs dictated the consideration of shoreline routes. Although construction costs certainly were a factor, routes located along the shoreline would have done little to reduce the congestion on local streets. The most obvious objection is that such a route is farther from potential

patrons than the residential areas of Berkeley, Richmond, and Oakland. Most severely affected would have been the short but high volume trips between these areas. Finally, shoreline routes conflicted with freeways which then existed or which had been proposed.

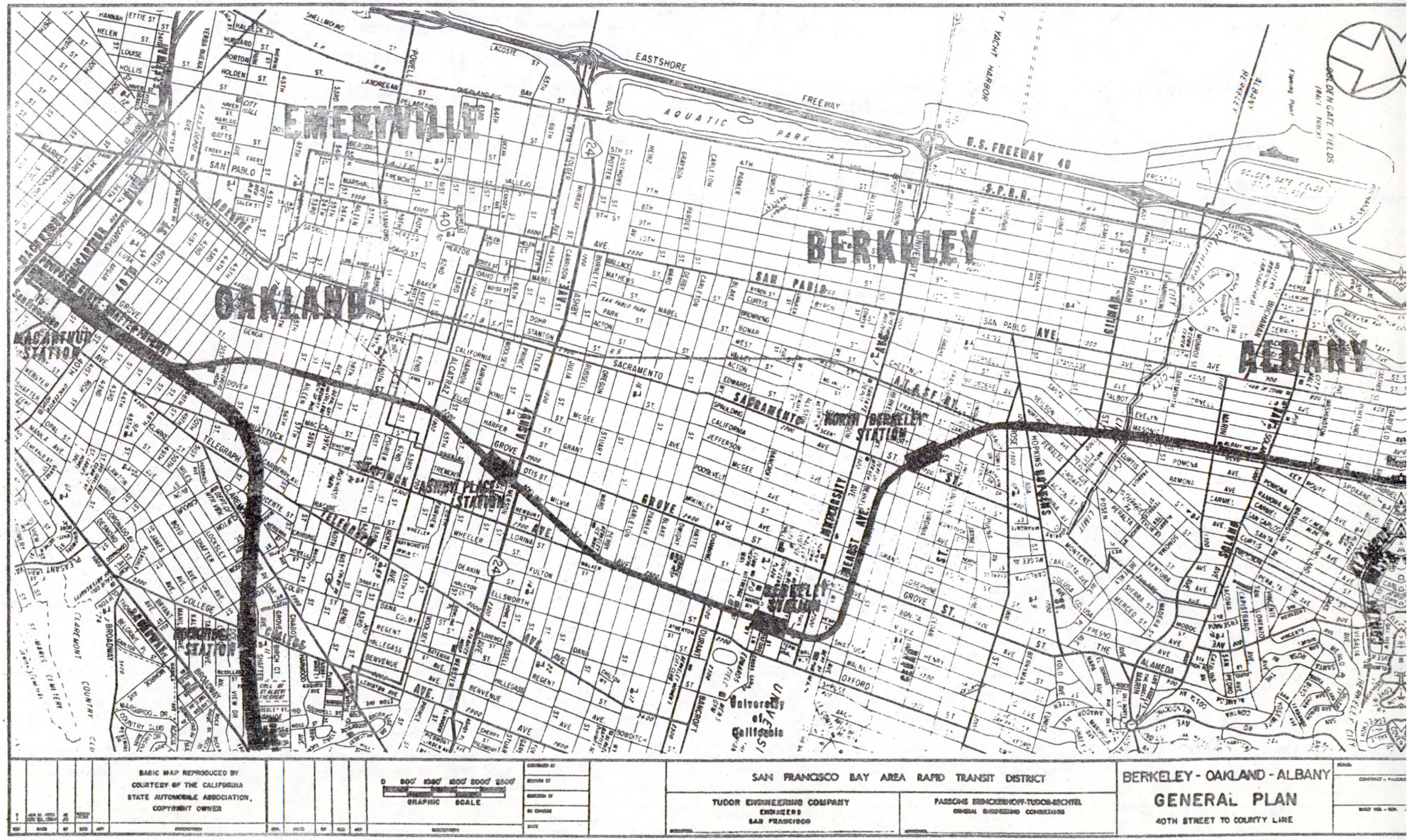
As can be seen from the maps, basically two transit corridors were considered, one located along the shore and another located along the easterly AT&SF railway tracks. As can be seen in Figure IV-2, the line as it was eventually constructed does not differ significantly from that which was proposed by the consultants in 1961. The precise alignments within this corridor were of course negotiated. These negotiations went on at some length as the BARTD tried to accommodate local desires. As will be pointed out, negotiations with Berkeley for an alignment which was entirely subterranean and with Oakland proved to be particularly time-consuming and expensive.

c. Southern Alameda: Oakland-Fremont

This line was to serve a plain some 30 miles long, 4 to 6 miles wide, and rimmed by San Francisco Bay on the west side and hills on the east side. The Nimitz Freeway generally bisects the developed portion of the plain, while the rapid transit routing was to be closer to the hill areas. The recommended route was to follow the main tracks of the Western Pacific Railroad from Oakland to Hayward (see Figure IV-3). The line was to be subterranean until just south of Lake Merritt and then would run at grade as far as 19th Avenue. From there, south to the Fruitvale and San Leandro stations, the line was to be an aerial structure. Throughout this segment, the line crossed the Western Pacific tracks to make room for stations located at Fruitvale Avenue, 77th Street, and San Leandro. Between the Hesperian Boulevard station and the Hayward station, additional right-of-way was required to provide for train storage and turnback facility. South of Hayward Station, the line continued on grade-separated structure to the center of Union City. A connection to Fremont (Figure IV-4) was not planned for the initial construction phase; however, the right-of-way was to be acquired and the extension was to be constructed as funds became available.

d. Alternatives

Few alternatives were considered for this portion of the system because a natural transit corridor existed along the Western Pacific routes. Moreover, it was felt that two routes, one to serve the westernmost and one to serve the easternmost communities of Alameda County, could not be



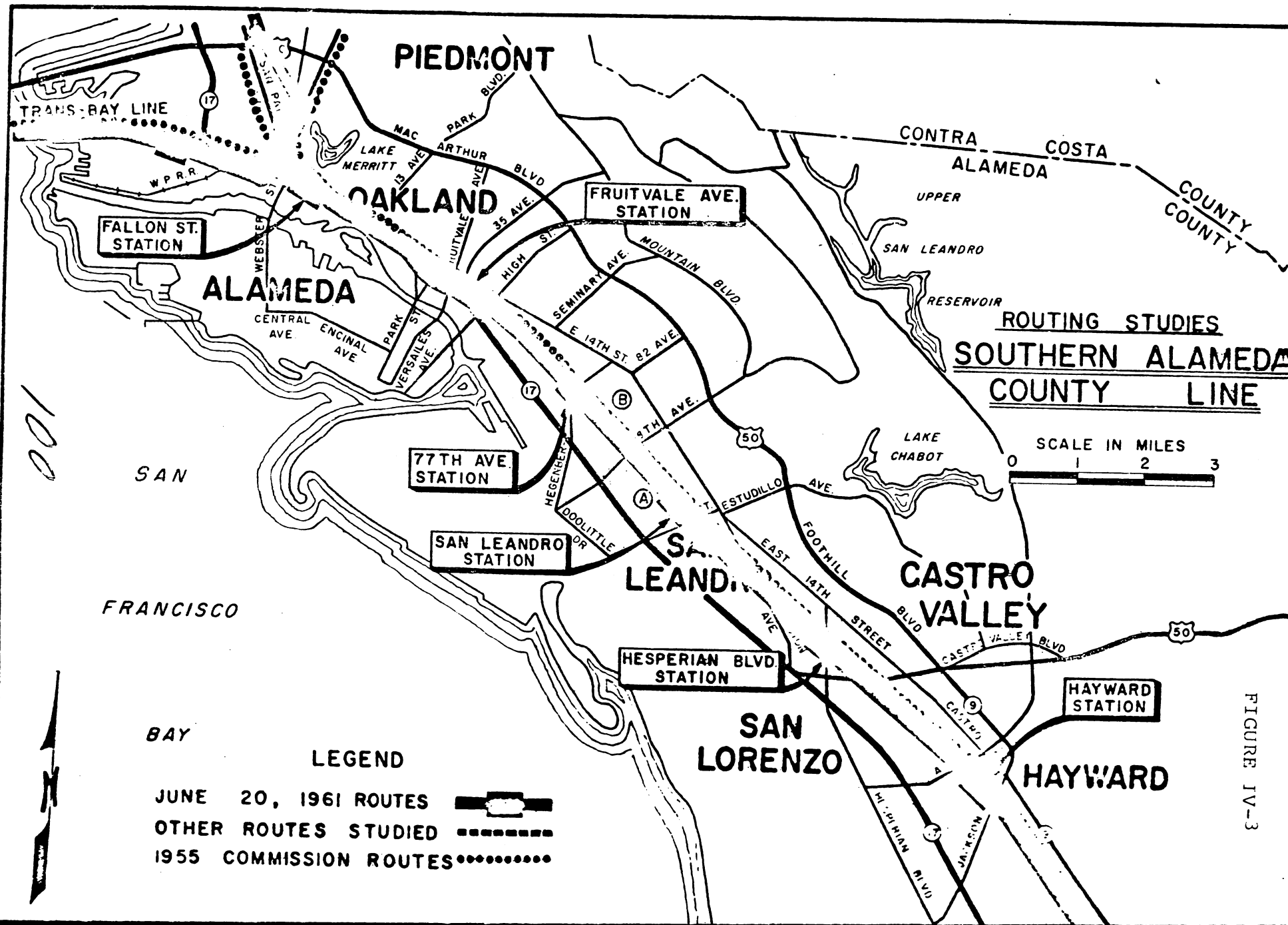
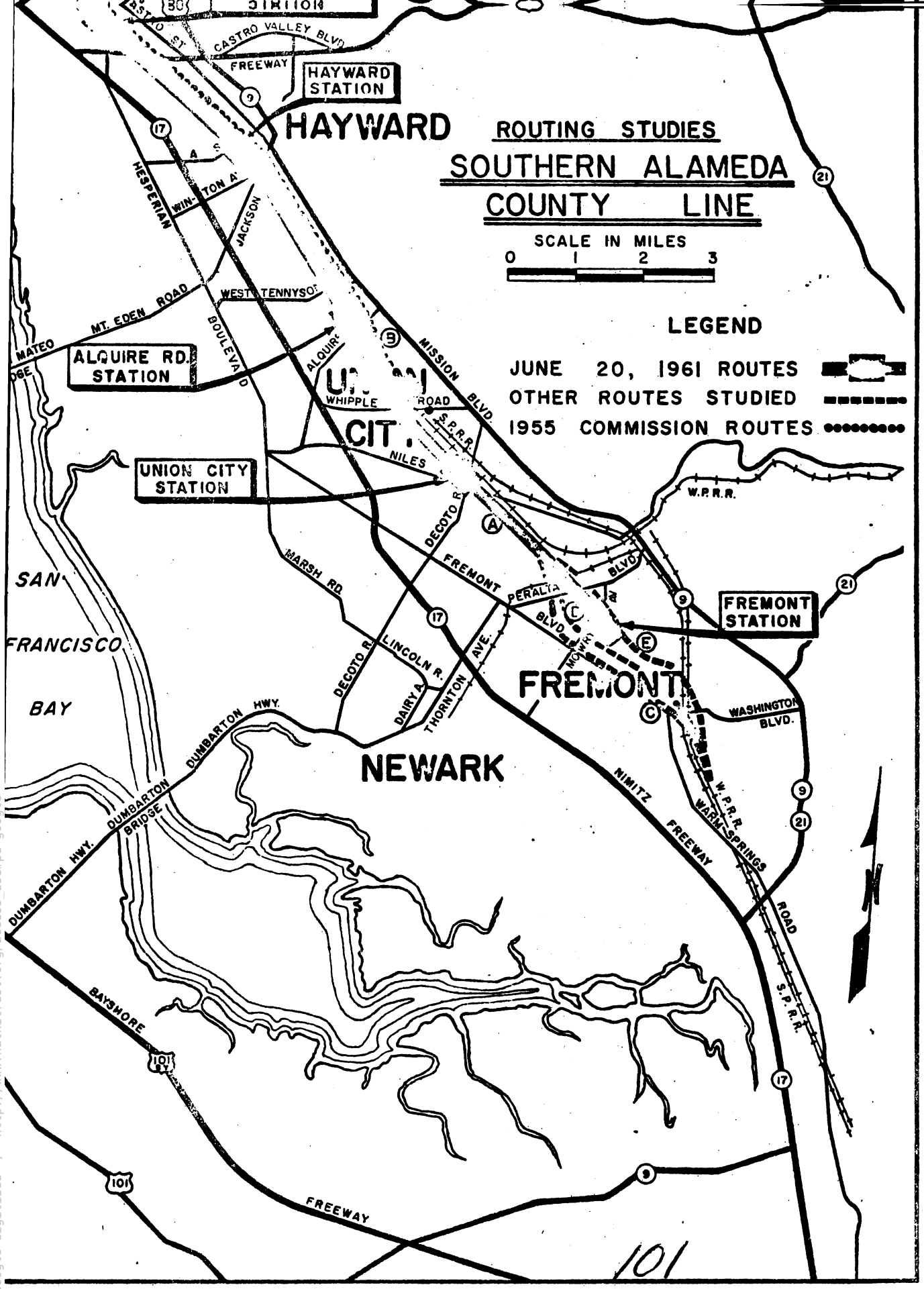


FIGURE IV-3

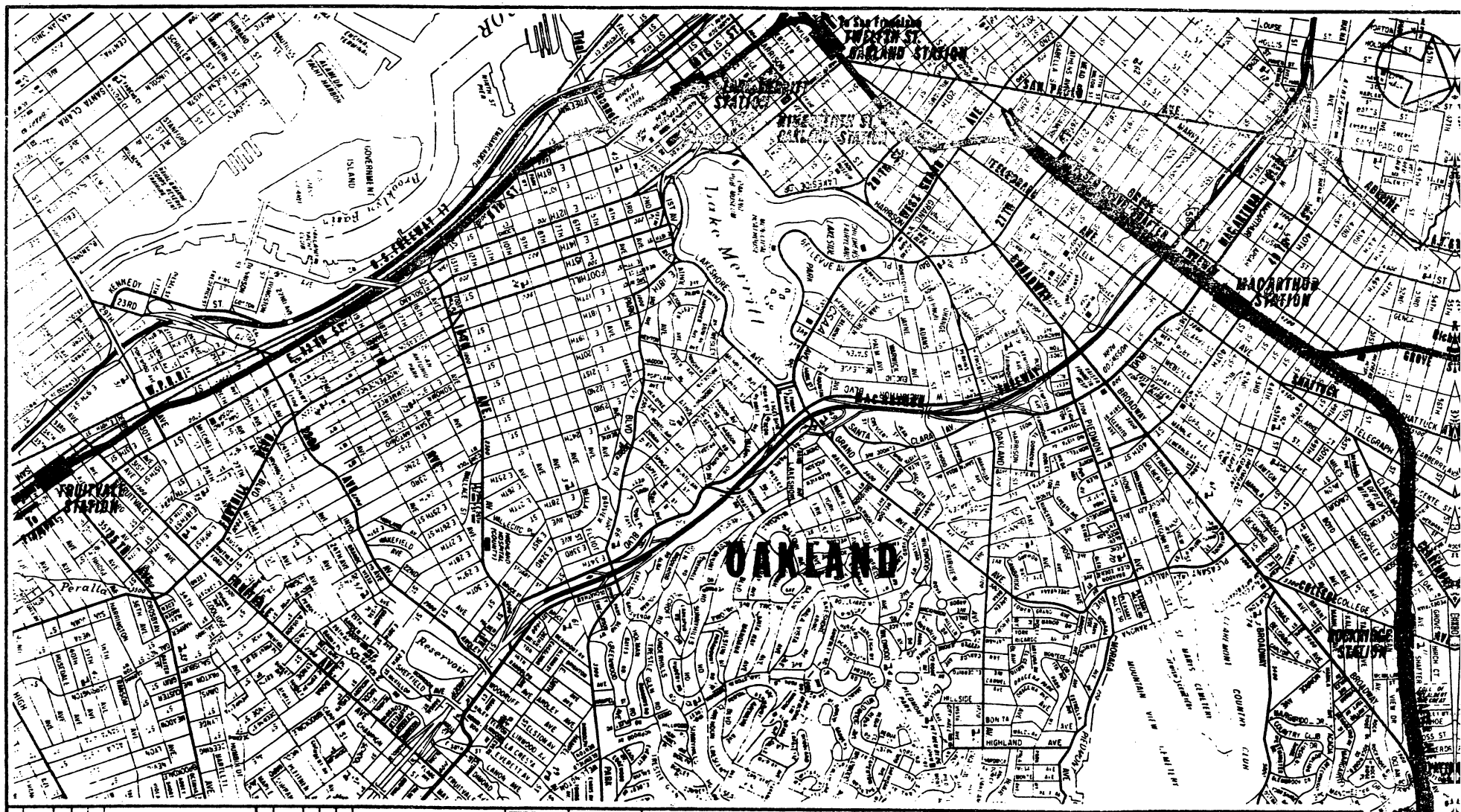


justified. Basically, the route which had been proposed by the Commission in 1955 (the dotted lines on Figures IV-3 and IV-4) was also the route recommended in 1961. One alternative which was considered involved combining a rapid transit line with the Nimitz Freeway. Such an arrangement often is urged as an ideal combination, but in the case of the Nimitz Freeway, three serious problems made such a scheme unworkable. First, the freeway median was too narrow to accommodate even the columns for an aerial transit structure. Second, twelve streets between Oakland and Hayward pass above the freeway lanes. An aerial structure of at least 40 feet would have been necessary to clear these obstacles. Third, although the freeway median widens somewhat south of Route 50, this additional space had been earmarked for expanded capacity. It was clear that such added traffic capacity was needed even in 1961.

An additional alignment was contemplated alongside the freeway. However, the difficulty of constructing rapid transit facilities through the numerous interchange areas as well as the costly acquisition of right-of-way for widening the freeway made this alignment infeasible. The Nimitz Freeway alignment was also objectionable from the standpoint of service to prospective patrons. Land use studies projected future growth eastward from the freeway, and it was felt that a rapid transit line should also be located to the east.

Another alignment which integrated rapid transit into the MacArthur Freeway was investigated. However, such a route would have made it necessary to construct complicated switching facilities and train turnback areas under Central Oakland so that transfers could be made between the various lines. Such an alignment also favored the Oakland residential districts at the expense of commercial areas. Finally, many of the physical obstacles associated with the Nimitz Freeway alignment were present with the MacArthur Freeway alignment. Parts of the freeway would have been nearing completion or actually have been in service before the rapid transit system could have been financed, thus necessitating costly reconstruction.

A final study was done using the Southern Pacific Railroad right-of-way. Such an alignment had many positive features in that railway gradients and curvature standards were compatible with rapid transit operations. However, the Southern Pacific line had many industrial turnbacks and interchanges. The rapid transit line would have had to rise above twenty-five such track turnouts as opposed to only twelve on the Western Pacific line. Community and railroad representatives



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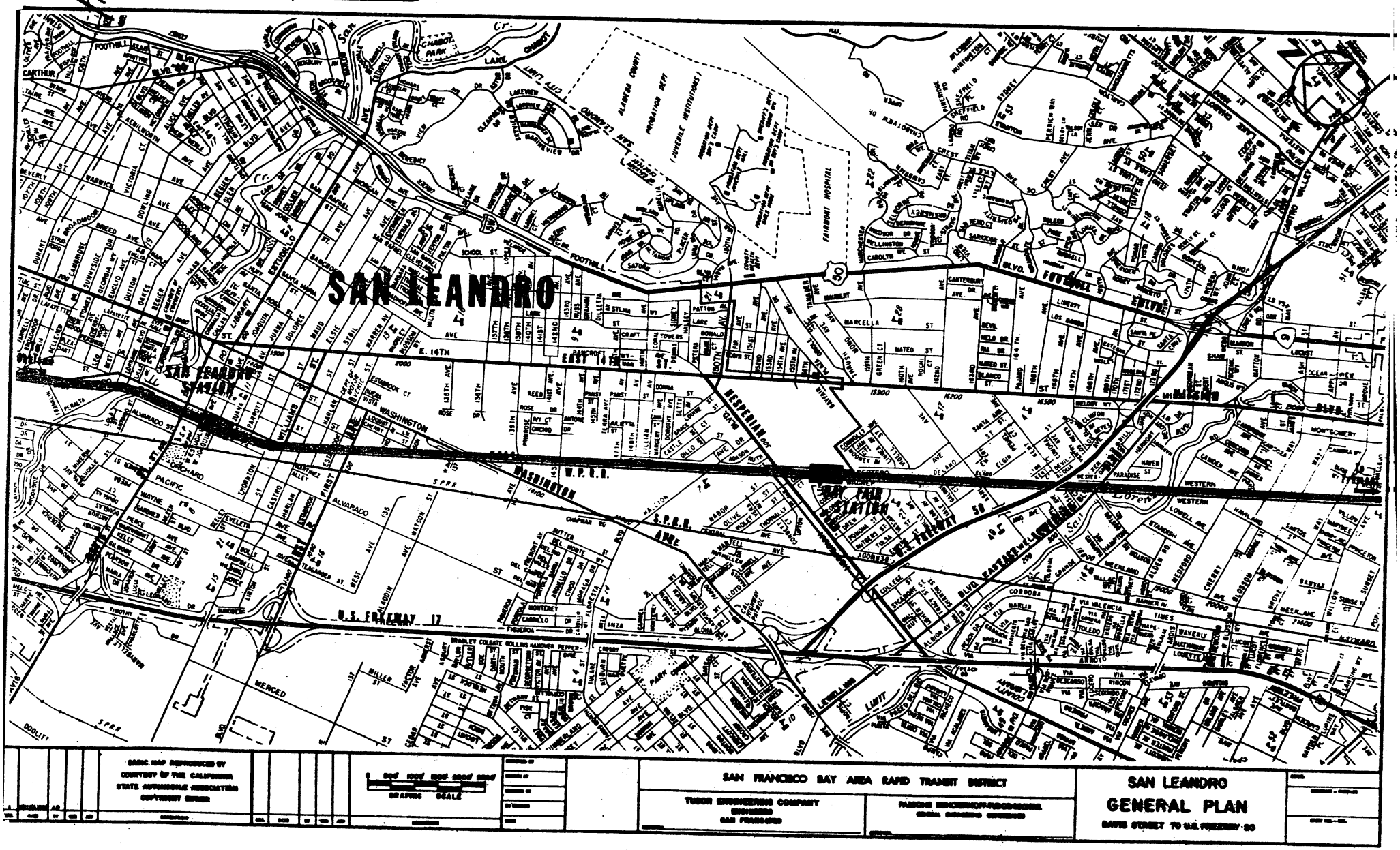

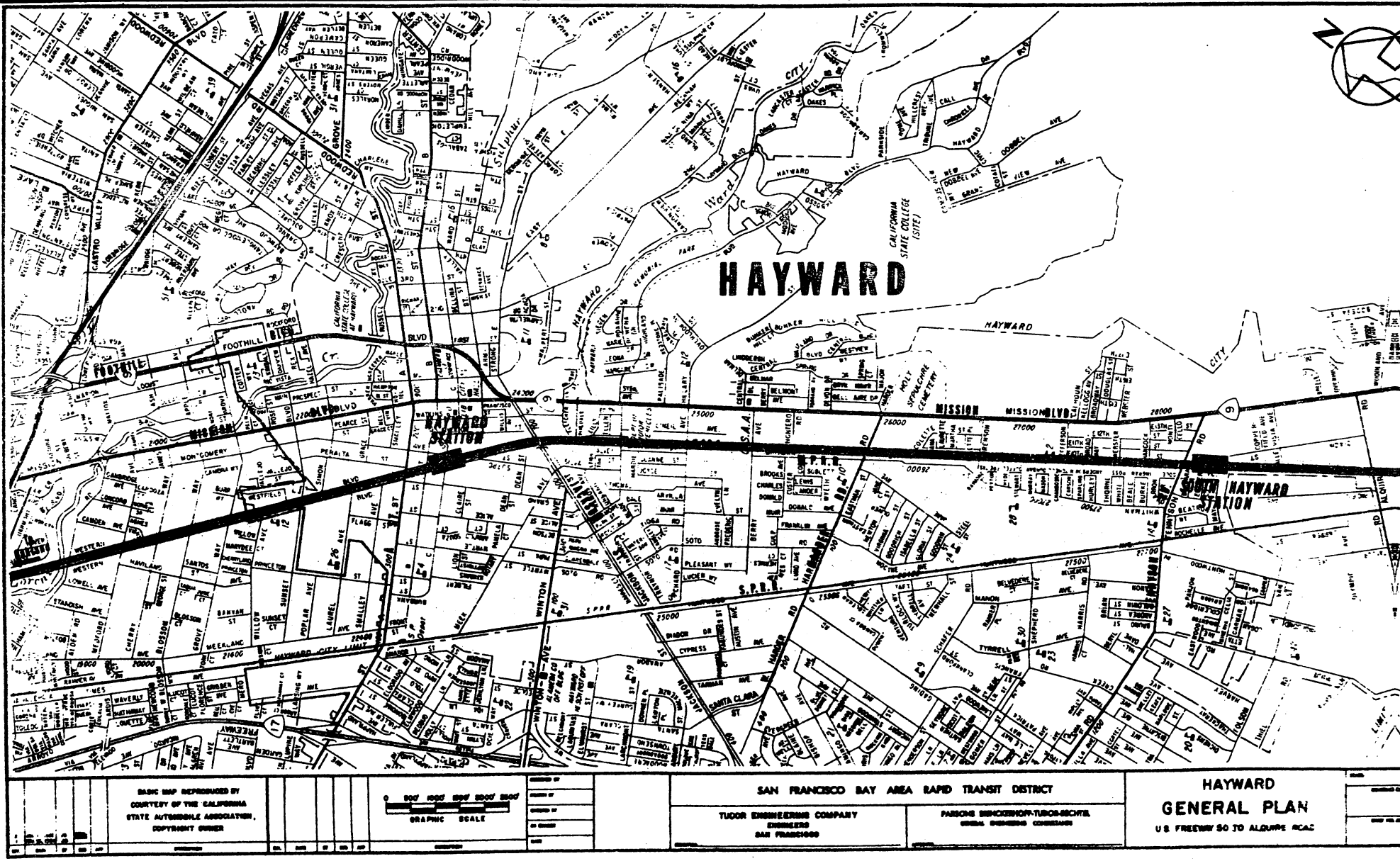

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felt that such a rapid transit alignment would disrupt access to industrial concerns along the route and thus hamper potential industrial growth viewed as necessary for the well-being of the area. Therefore, the Western Pacific route was recommended from the standpoint of service to the communities, transit operating characteristics, and construction costs.

Figures IV-5, IV-6, and IV-7 show the alignments of this system as it was finally constructed. It can easily be seen that only minor changes were made from the consultants' recommendations, except for the Fremont construction (Figure IV-4). This extension resulted from a series of compromises among the BARTD Board of Directors and is discussed at some length later.

There are many examples of BART's need to accommodate local communities in routing decisions. The best publicized, of course, was Berkeley's determination for subway alignment, which is discussed in Section IV-B(3e).

Also, in Hayward, after the bond issue was passed, the local Councilmen decided that the alignment in the Western Pacific right-of-way, to which they initially had agreed, no longer served their purpose. They had decided to build a new civic center and wanted BART to serve both the civic center and the college which was being constructed south of the city. Thus, BARTD was asked to provide a feasibility study for the so-called "Alpine route." While the Alpine route would have been considerably more expensive for BARTD, they conducted the study. The city and BARTD finally reached a compromise to drop the alignment to grade with grade separations.

Two other examples have been cited by Homburger:

> "The city of Albany, population 18,000, with little industry except for a race track, much government-owned real estate paying no taxes, lies in the path of the Oakland-Richmond line. Fearful of losing some of the tax base left to it, the city strenuously opposed the alignment and the location of Albany station and its parking areas, proposing instead a route along the shore of the Bay. Immediately to the south, the city of Berkeley heatedly protested Albany's suggestion, because such a change would add to its loss of taxable real estate. The route was finally left in its original location, but the station was shifted north into neighboring El Cerrito. While this reduced the land to be acquired within Albany, it also decreased the usefulness of the system; Albanians will have to walk, drive or take a bus into an adjacent city before they can board a BARTD train."

> "In another conflict (which was not settled until 1964) BARTD had a change of mind. Its official plan, as approved by the voters, showed the Richmond station west of the downtown area. Further study indicated that a location along the Southern Pacific Railroad east of, and slightly further from downtown, would save in route length and cost, would lead to a preferable location for a yard and shop area, and would be a more logical point from which to build an extension in the future. BARTD therefore proposed this change to the city officials and found them almost evenly divided on the alternatives. Downtown interests wanted the station to remain where it had been planned, feeling that the new location would be of less benefit to them. Some city officials preferred the new alignment because BARTD would provide grade separations of several important arterials under the Southern Pacific at no cost to Richmond. After much debate and threats of lawsuits (which never materialized) the new location was finally approved by the city council, and the BARTD plan was amended accordingly."[1]

One major decision which affected the transportation system, particularly the need for an automatic train control system, was the decision to have three routes converge in downtown Oakland prior to entering the transbay tube. Naturally, a convergence of three lines, given the anticipated 90-second headway standards, requires an extremely well-coordinated train control system.

Two influential members of the Rapid Transit Commission conditioned this decision. Commissioner R. W. Bruener of Contra Costa County is alleged to have said: "I know retail business. All trains should stop in Oakland."[2] This display of commercial interest in reviving Oakland was echoed by a second Commissioner, Sherwood Swan, of Alameda County. Together, they encouraged the routing which, circuitously, caused trains to pass through downtown Oakland.

The influence of strong, respected or persistent Board members, then, was not unprecedented. Director George Silliman of Alameda County felt very strongly that direct service from Fremont should be provided to San Francisco. His influence assured this service from Fremont, even though it would not be provided initially from Richmond.

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[1] Wolfgang S. Homburger, "Mass Transit Planning and Development in the San Francisco Bay Area," pages 110-111.

[2] Interview with Harry Moses, formerly director of community relations for PBTB, April 24, 1975.

A noted instance of local pressure affecting BART technology involves the location of the downtown Oakland interchange. This is a Y shaped series of tunnels which interconnect the Richmond-Fremont line with the Concord-Daly City line. The initial alignment placed one arm of the Y along Eighth Street in Oakland, directly underneath the building of Simon's Hardware, Inc. At the time, Simon's was a prosperous downtown business and the only major hardware concern in Oakland. The firm had done $9-10 million in annual sales.[1] The cut and cover method of tunnel construction would have made it necessary to remove the building and relocate the business. Faced with such a loss, the then Mayor John Houlihan and Warren Isaacs, then director of the Downtown Businessmens' Association, asked the District to reevaluate the alignment decision.[2] Although the District was willing to relocate the business and Aaron Simon, the owner, was amenable to that alternative. The city did not want to create a commercial vacuum at that location by displacing the hardware business, nor did it want to lose the tax revenues. The city was adamant that Simon's Hardware must stay. To accommodate this demand, the BART route was redefined, passing through only a portion of the parking area of the Hardware Store. Agreements between the District and the city were made in 1963, which had severe implications on BART's operational characteristics.

The alignment was changed to avoid Simon's Hardware and this resulted in a tight radius curve in the interchange. Although these curves are within the 500-foot radius standard established by the engineering staff, they are too sharp to allow high speed operations and the trains are currently limited to about 25 mph in this section of the route.

Ironically, Simon's Hardware experienced financial difficulties during the construction phase of the project and went bankrupt in 1969. In 1970, the store was closed.

All route location decisions, therefore, were not devoid of local influence. At least two BARTD officials involved in early planning decisions prior to the bond election have cited examples of BARTD's extreme sensitivity to the need for local acceptability. Prior to the bond issue election, as route location decisions were being further defined, it was essential that the Boards of Supervisors of each of the BARTD

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[1] McDonald & Smart, Inc. interview with Aaron Simon, Simon's Hardware, Walnut Creek, California, August 22, 1975.

[2] McDonald & Smart, Inc. interview with Robert Pherson, BART July 16, 1975.

counties vote to place the BARTD bond issue on the ballot. To that effect, it has been alleged that route location decisions into the City of Concord were made in an attempt to encourage the support of a seemingly skeptical supervisor from that area. It also has been alleged that the original engineering plans for the first stage would have terminated the Richmond line at El Cerrito. The Board of Directors and the General Manager, however, felt that it was essential to run the line into Richmond in order to gain the vote of northwestern Contra Costa. Later, when BARTD was encountering financial difficulties, this decision was certainly vindicated as Assemblyman John Knox sought support for sufficient funding to complete even the extremities of the first stage of BART.

The location of the Fremont line in Oakland along the tracks of the Western Pacific Railroad, east of the major concentration of the city's population, was the result of community demand and poor coordination among transportation planners. In the early planning, PBHM sought a route further east into Oakland and San Leandro, similar to the route of the present MacArthur Freeway. At that time (1953-1955), however, MacArthur Freeway had not yet reached final planning stages in the highway division. Although BART wanted the easterly location -- both to serve population and concurrently "to increase its patronage projections" -- the cities of Oakland and San Leandro were adamant in wanting to preserve the geographic and social integrity of the communities: "Since BART will be a railroad, run your tracks down by the other railroads." There was considerable concern about a railroad dividing the towns. Hence, BART's route was moved to the right-of-way occupied by the Western Pacific Railroad near the Bay.

The difficulties of comprehensive transportation planning during the Fifties are reflected in this decision. BART's planners sought a route similar to that presently occupied by MacArthur Freeway. BART's early plans, however, were published with the Fremont route along the railroad right-of-way, on local insistence. Consequently, highway planning proceeded to develop a highway in the easterly corridor sought by BARTD; the MacArthur Freeway was engineered before BARTD had the voter approval necessary to negotiate coordinated planning with the Division of Highways. The freeway eventually split the city in a way which BART was not permitted to do.

While BART might have shared the right-of-way with the freeway, serving the residential population of Oakland and San Leandro before continuing to Fremont, it had no leverage with which to encourage the Division of Highways to engineer the freeway with the capability of accommoding BART. Thus, without a commitment of funding until the bond election passed, final engineering and construction of the freeway proceeded in the early Sixties with no allowance for sharing the right-of-way with transit. By the time the bond election had passed, it was no longer possible to engineer an aerial structure or at-grade structure on the MacArthur right-of-way.

e. San Francisco

In San Francisco, the route was determined by the need to serve the residential areas in the southwest sector. This route initially was conceived as continuing to San Mateo County; once the determination was made to serve San Mateo, there was little alternative open to the route planners. The route between the financial district and Daly City was dictated by a natural path of communication set by Market Street, Mission Street, and Bernal Pass. When San Mateo County withdrew from the District in 1961, the San Francisco BART route remained unchanged, since the planners continued to have confidence that ultimately San Mateo would join the BART system.

Despite tne high cost of subway construction, in the downtown area it proved essential because of the density of existing buildings. It emerges to an at-grade alignment east of Mount Davidson, to follow the right-of-way of the Southern Freeway, ending at Daly City.

The subway alignment on Market Street was considered from the first to be an essential element of the optimum plan for BART. The reason for this alignment is contained in "Regional Rapid Transit":

> "The plan for interurban stations along Market Street must allow for the prospect that San Francisco may some day have grade-separated transit for its own urban movements. Clearly, such a local rapid transit system must make delivery along Market Street also. Thus, if interurban transit were to be elevated along Market Street, it must be assumed the local urban rapid transit would be elevated also. Such a program would involve four tracks with massive stations over 600 feet long covering essentially the entire width of Market Street. We are convinced that elevated construction over public streets involving four tracks and the stations to serve them would be aesthetically intolerable and would depreciate the very real estate values that they would be designed to sustain."

The decision-making process concerning improvements to Muni were more complex. In the Preliminary Engineering Report for a Five-County System published in 1961, PBTB planned a two-tiered tunnel on Market Street between Montgomery and Gough Streets. The upper level was to be utilized initially by streetcars. At this point in time, however, the Marin line still existed, along Geary Street through the Western Addition to Presidio Avenue. When the Marin portion of the five-county system was deleted, negotiations opened with the City of San Francisco on the nature of the San Francisco system. A plan of transit improvements had to be developed for the City which would meet the District's planned commitment to the City and, importantly, would prove sufficient for voter approval.

BARTD needed to satisfy the San Francisco voters. Nonetheless, BARTD felt itself within the constraints of limiting the system's total cost to $800 million (excluding the tube and rolling stock) and, although not explicitly, balancing the expense of the system in each of the three participating counties (the incidence of the expense of the total system in each county actually did nearly equate to the ratio of the assessed value in each county).

The negotiations were conducted with the San Francisco Technical Advisory Committee, which coordinated the input of up to 13 other citizens groups. The City's position was that it wanted a Geary Street rail line, even without the Marin line, and wanted the subway extended for the streetcar system on Market Street all the way to St. Francis Circle. This position proved unacceptable to BARTD, which could neither finance nor justify that extensive an improvement in San Francisco alone. It is necessary to keep in mind that, at that time, improvements to the BART system needed to be considered viable in terms of self-sufficiency from the fare box. Finally, the Technical Advisory Committee chose among fourteen alternate versions of route plans for San Francisco. The chosen plan, two weeks later, emerged as one with a price of $20 million more than originally allocated to San Francisco.

The settlement eventually resulted in BART assuming responsibility, at least initially, for completing the Muni subway on Market Street as far as the East Portal, reconstructing the tunnels in the Portal itself, and constructing a subway from the West Portal to St. Francis Circle. A number of events changed this plan. Merchants and residents opposed the subway alignment between West Portal and St. Francis Circle. The concern was based upon the disruption which construction would effect and the impact an underground transit alignment would have on the visibility and accessibility of merchants. The merchants and homeowners approached the Board of Supervisors to protest against the subterranean transit.

Simultaneously, pressure was mounting for a transit station at Davis Street on the Embarcadero in the Financial District. Thus, while the proposed alignment was being rejected by the local community beyond the West Portal, the City was searching for funds to assist in placing a station at Embarcadero. This location was one not included in the preliminary plans for BART. In the interim, however, the City's Redevelopment Agency had been able to stimulate considerable development on previously underutilized land on the fringe of the Financial District. The partnership which was to develop over three million square feet of office and retail space in the area, in addition to an 840-room hotel, applied its leverage. This pressure, among others, supplied an incentive for the city to construct the Embarcadero station.

The City began seeking BART cooperation, as well as funding assistance in developing an Embarcadero station. The incremental funds made available by constructing the Muni track beyond the West Portal at grade was applied to a Muni station at the West Portal, with the remainder being applied to the expense of the Embarcadero station. The City's remaining portion of the costs of developing that station were raised through tax increment bonds on the redevelopment area.

f. Transbay Tube

The decision to build a transbay tube rather than utilizing Key System tracks on the Bay Bridge was the determined vision of the early planners that only fast and convenient transportation would be effective in reducing dependence upon the automobile. The engineers felt that a bridge-borne system could not possibly reduce travel time between Oakland and San Francisco much below 22 minutes. With a transit tube, however, the elapsed travel time was projected at less than 11 minutes. This determination to provide a rapid interurban system narrowed the alternatives to a transbay tube, although the "Regional Rapid Transit" report in 1955 fully described a minimum system using the Bay Bridge as a transbay alignment. Nonetheless, the minimum system description recognized the significant problem of route alignment on the Bridge's western approaches. In order to maintain the performance standards, the system would certainly not need to go underground in San Francisco. The minimum system would certainly not permit easy transition from Bridge-borne tracks to the Market Street subway.

The original Commission had assumed the transit system would use the Bay Bridge when it charged the consultants to prepare a regional transit plan. Arthur J. Dolan, Jr., a member of the Commission, credits PBHM with the imagination to construct a tunnel.[1] John Beckett, on the other hand, Chairman of the Engineering Committee which selected the consultant, notes that PBHM was always noted for its tunnel technology, an expertise evident in the novel anti-earthquake joints at the tunnel and approaches. Further, once the report was prepared, the minimum plan, without the tunnel, was given such short shrift by the engineers that it was never given a chance as a viable alternative.

3. Coordination with the California Division of Highways

While coordination with the Division of Highways was not possible in the case of the route location for the Fremont line south of the Wye, joint planning by BARTD and the California Division of Highways proved effective and mutually beneficial in a number of cases. This coordination has been credited to the attitudes of a succession of district engineers in Highway District 4 (with jurisdiction for the entire Bay Area) starting with Barney Booker in 1954. Booker recognized that -- based on the origin/destination studies of the PBHM report, the most comprehensive contemporary study -- future freeway capacity would not carry all of the travel demand. Thus, BART was identified as a supplementary transportation approach to the highway network. With this understanding, shared, sometimes reluctantly, by a succession of highway engineers, joint rather than competitive use of rights-of-way for both freeways and rapid transit was effected after the bond issue for approximately 18 miles of joint alignment.

BARTD's first relationship with the Division of Highways, as far as joint alignment is concerned, was its agreement on the Grove Shafter Freeway at the MacArthur interchange in north Oakland. The BART alignment is in the median of the new freeway for 3.5 miles through a densely developed urban area. In this case, BARTD's only alternative would have been subway or aerial alignment; in the 1955 report, the Concord line was routed out Broadway. By 1960, through discussions with the Division of Highways, it appeared the Grove Shafter would be under construction concurrently with the proposed rapid transit system. Thus, planning proceeded on the basis of BART occupying the median of the new freeway.

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[1] McDonald & Smart, Inc. interview with Arthur J. Dolan, Jr.

The decision to share this right-of-way was one of the most immediate urgencies for settlement of a taxpayers' suit immediately following the bond election. The Division of Highways had to commit for freeway construction shortly after the bond election. Because of the urgency of developing a joint design, PBTB worked with the California Division of Highways design staffs even during the taxpayers' suit, without certainty of compensation. Nonetheless, the start of freeway construction was delayed 30 months because of design changes. The agreement had mutual benefits which prevented the cooperative relationship from deteriorating from the delay.

The agreement provided that BARTD would pay for the Division of Highways' previous design plus 25% of a new design for the 3½ mile stretch, including the MacArthur Boulevard interchange. BART also paid the fee value of right-of-way occupied by its facilities plus a percentage of the cost of slope areas and clearance to the freeway fence, one-half of the costs of frontage roads, landscaping, and fencing, all of the costs attributed to BART specifically, and a proportionate share of utility relocations. The respective savings have been estimated at up to $75 million for BART and between $5-6 million for the Division of Highways.

Further on the Concord line, between Orinda and Walnut Creek, BARTD established a route aligned to the south of an existing freeway for 6.5 miles. In this case, portions of the freeway were four lanes and others six lanes wide. The agreement which was reached with the Division of Highways in this case provided for BART to pay the costs of widening the highway to eight lanes, an improvement planned by the Division of Highways, but not programmed for at least another decade. Although the cost of the highway expansion was ultimately to be borne by the Division of Highways, BARTD advanced the necessary funds. The costs of this work was approximately $32 million. The agreement also called for BART to pay all costs of placing tracks in the widened median and a negotiated sum for the benefit BARTD received from the existing roadway.

In San Francisco, BART runs along an existing freeway and parallels it for some 3.5 miles. Again, BARTD paid all costs associated with its construction plus a negotiated settlement representing BART's benefits and savings from the prior construction of the highway. Unfortunately, the costs of this agreement and the construction time could have been reduced substantially if BARTD had been able to enter into planning arrangements prior to the bond election. But, as with the MacArthur Boulevard route, BARTD was unable to benefit from construction related to the Southern Freeway prior to 1962.

The inability to coordinate transportation facilities within a region are exemplified in the cases of BARTD being unable

to take advantage of the construction of MacArthur Freeway and the Southern Freeway. A need which must be recognized is that transit planning should be considered an element of comprehensive regional transportation planning, rather than dysfunctionally relying on a separate political entity which focuses on transit planning in contrast to highway planning. In the case of regional rapid transit for the Bay AREa, mutual savings would have accrued to each transportation mode, compounding the savings which the public would have realized. The absence of firm direction by a regional transportation agency is made even more poignant by the eventual assignment of a future transit mode to the MacArthur Freeway corridor by ABAG, the regional planning agency, after its creation in the early Sixties (and after the Freeway's completion).

A further example of cooperation between the Division of Highways and BARTD relates to the BART route south of Hayward, which parallels a future freeway for approximately 4.5 miles. While plans are not yet complete for the freeway, the alignment has been established. Hence, an agreement was negotiated for BARTD to purchase through "total take" transactions sufficient common right-of-way for future mutual use..

BARTD also effected a railroad relocation necessary for both the transit and the freeway alignment. The state was to reimburse BARTD when the freeway is to be built. While BARTD had hoped to use these acquisition plans, developed in 1960, as leverage for the state's providing an alignment for BARTD on the Southern Freeway, the state's attorneys discouraged any agreement for fear of a potential charge of an improper fiduciary interest in the Division of Highways on behalf of BART.[1]

B. Construction of a 71-Mile Rapid Transit System

The successful bond issue election on November 6, 1962 was the clear public signal that implementation of a regional rapid transit system was to become a reality. Up to that time, those most intimately involved in rapid transit planning, including the immediate BARTD staff and the PBTB planning and engineering team, were working toward a single goal: bond issue approval. While the 1956 "Regional Rapid Transit" plan provided the early planning basis for an interurban rapid transit system, the engineering effort between 1959 and 1962 was primarily an elaboration of that early planning effort in order to project more accurately the costs and the configuration of the ultimate system. This definition was essential for gaining voter approval in the bond election, and even more essential in establishing the cost the public would bear in voting in favor of a regional transit network. Once the bond election was passed, the District had the mandate to construct the 71-mile system presented to the voters.

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[1] McDonald & Smart interview with Harry K. Moses.

Actual design and engineering of the system, as well as construction, did not commence until after the November election. The contract entered into between the BARTD and PBTB in 1959 called for the engineering to "perform engineering services as required in finalizing and completing a plan and program for construction of a rapid transit system for the San Francisco Bay Area." The contract did not include final design and construction of the system within its scope.

1. Selection of Contractor

Immediately after the election, however, the planning momentum urged the District to get on with the final engineering and design necessary for construction. The District considered the Joint Venture the appropriate contractor since it had completed all of the preliminary engineering. In fact, the line between the contractor and staff already was nearly indistinguishable. Even Stokes has admitted it was difficult to know, in those days, who worked for whom.

Selection of a contractor to manage and oversee the implementation of the mandate of the election was not put out for competitive proposals. Despite the magnitude of the contracts involved in building a $1 billion system, there was never any question at the District that PBTB, who had provided the final planning and programming for the system, would be responsible for construction management. In fact, the original marriage of the three firms was based partially on the desire to enhance the construction capability of Parsons, Brinckerhoff, Hall and Macdonald, the predecessor of PBQD which had been responsible, under Walter Douglas, for the "Regional Rapid Transit" report. That marriage, however, occurred in 1959; by 1962, the Joint Venture was sufficiently integrated into the small core staff at the District that decision responsibilities were not absolutely clear. One of the issues of the citizens taxpayers' suit challenging the bond issue election, in fact, was the relationship between the two.

The Board of Directors decided that PBTB should be retained subsequent to the bond election campaign. A decision was made not to solicit proposals; and, on November 15, in an open meeting, the Board decided to set a date for the next meeting, at which time the retainer agreement would be approved. On November 25, the taxpayers' suit was filed which included an injunction against the Joint Venture billing any cost to the District or BARTD paying any invoice to the Joint Venture until settlement of the suit. On November 29, at the scheduled meeting of the Board of Directors, the retainer was signed. Once the injunction was served, no disbursement of funds for further design

or construction was permitted until settlement of the suit, which did not occur until the following summer. The Joint Venture, however, proceeded to work and accrue expenses on their own assurance that the suit would be settled in favor of the District.[1]

2. The Terms of the Retainer and Their Implications

The construction and operation of a large rapid transit system involves a comprehensive scope of activities, including engineering and construction, insurance, utility relocation, and procurement contracts. The magnitude of this contracting responsibility is substantial; administrative control alone would require a substantial staff. The Directors determined that the appropriate means for providing administrative control over the contracting process was to retain a single engineering Joint Venture which would administer and evaluate the progress of all subcontractors.

With the approval of the 1962 retainer agreement between BARTD and PBTB, PBTB assumed responsibility for directing the total engineering of the basic BART system to include overall system planning through research and development, design and management of construction, and startup and qualification testing of all facilities and systems. In some measure, this retainer agreement called for the delivery of a "turn-key" revolutionary rapid transit system. Later, the introduction of operational responsibility and review of ultimate equipment delivery would revert to the BARTD staff, particularly after 1967, when confidence in the Joint Venture's control was beginning to wane slightly and the need for operational input became manifest. In 1962, however, PBTB was sanctioned with full responsibility for implementing the mandate for a regional transit system.

During the planning stages of BART, Parsons, Brinckerhoff, Quade and Douglas (previously PBHM) had assumed overall responsibility for Joint Venture management and for technical progress. While Tudor and Bechtel had their respective roles in the final planning studies of 1959-1962, PBQD provided leadership and project control, a role predicated on PBQD's considerable public construction experience and planning capability (which had resulted in "Regional Rapid Transit" in 1955).

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[1]McDonald & Smart, Inc. interview with Richard J. Shephard, District Secretary, BARTD.

Construction of the first rapid transit system in a half century, however, was clearly a massive public works undertaking. The need was evident to include a construction firm capable of realizing the plans for 71-mile transit system and a transbay tube. Thus, Bechtel Corporation, a San Francisco firm which was among the largest engineering construction organizations in the world, was made a part of the Joint Venture in 1959. The understanding among the partners, under considerable pressure from Steven Bechtel, was that Bechtel would assume leadership of the Joint Venture during the implementation stage (subsequent to the 1962 election). Members of the Joint Venture who were present during the negotiations of the Joint Venture marriage encouraged by the Board have indicated that Steven Bechtel, a leader of the Bay Area Council and a prominent Bay Area businessman, was reluctant during the initial negotiations with Walter Douglas in 1959 to give up the leadership and management role of the Joint Venture even during the final planning stages.

Although the Board of Control of the Joint Venture granted each firm a single, and equal, role, the financial agreement -- hence real control -- finally effected called for PBQD to retain a 50% interest in the pre-election Joint Venture, with each of the construction partners, Tudor and Bechtel, to retain a 25% interest. After the election, the interest shifted: Bechtel gained control of the management of the Joint Venture and 45% of the financial interest, while PBQD and Tudor retained 27½% of the Joint Venture each.

Interviews with many of the knowledgeable and involved participants indicate this shift in leadership occurred with some chagrin among the PBQ&D people who had been so instrumental in developing the vision of BART. While Bechtel was experienced in massive construction projects, its experience was less impressive in having to deal persuasively with the sensitivities of public groups as diverse and vocal as BART's constituency. The interaction with public agencies, a mode of business familiar to PBQ&D, was not a normal experience for Bechtel, whose reputation had been made in massive construction of turn-key projects. It has been alleged that this leadership change brought insensitivity to the project without enhancing management control. Furthermore, the pressures brought to bear on PBQ&D to associate with a local firm to engineer electrical and train control systems, rather than PBQ&D's more experienced first choice, may have been detrimental to ultimate system performance.

Under the design, development, and construction management retainer, PBQ&D assumed responsibility for the design of the transbay tube; Tudor designed the aerial structures used on 25 miles of line; and Bechtel designed the third rail electrification system, monitored the development of the automated train control system, and provided overall management direction. Together, PBTB monitored and controlled all aspects of facility construction and system installation which included inspection and final approval of the completed work. Approximately 300 contracts were involved in designing, constructing, equipping, and starting up the BART system.

While BARTD's responsibilities in the area of contract administration legally extended from the point of contract advertising through the final contract analysis to achieve financial closeout of each of the construction, capital equipment, agency, and utility relocation agreements, BARTD delegated its responsibilities for direct dealings with contractors to PBTB. These responsibilities included:

-- Overall management of design, construction, and route development activities;

-- Control of design and construction costs; and,

-- General planning for startup, qualification testing, maintenance, and operation of the completed transportation system.

In order to provide an organized approach to the management of construction contracts, BARTD and PBTB established a set of policies and procedures for their joint use.[1]

These instructions on change orders deal with the process by which BARTD controlled changes resulting from design changes, field engineer changes, contractor recommended changes, omissions, increased or decreased work related to the original contract, and District or contractor caused delays. While the Board of Directors was charged with reviewing and approving project expenditures in excess of $3,000, this review policy proved cumbersome in dealing with the changes which occur in a billion dollar public works project. Thus, the Board delegated the authority to approve change orders up to $200,000 to the General Manager.

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[1]"Change Order Authorities, Procedures and Practical Considerations," BARTD.

BART's record for contract changes and claims was less than 5% of construction cost, which is not excessive by public works' construction standards. A more significant problem lay in the occasional disparity between specifications and expectations, which caused a completed project at a given price to appear inadequate. Design changes, which cause additional cost, can be mistaken for overruns.

Through 1965, of course, the need for strong control was not apparent either; the District still retained a sense of euphoria, borne of the public mandate, the magnitude of the resources available, and the challenge of ultimate "new technology" solutions. Technical alternatives were studied at will, and the receptive bond market provided capital funds, which were earning interest in excess of bond payments. Thus, the need for strong management control did not surface until 1965, when the drawdown of funds was obviously occurring well before the associated benchmarks of system completion.

One alternative to the delegation of contract authority to PBTB might have been considered. Establishing full contract management and control capability within the BARTD staff was dismissed as inefficient in the GK report on staffing produced in 1963. The absence of sufficient staff even for adequate contract management review was to prove a weakness condemned by both Stokes and Dahms. BART was dependent upon PBTB to manage and review even its own work. Initially, all alternatives were considered internally by PBTB, with single recommendations emerging from their studies. This approach reduced the ability of BARTD to choose among alternatives. Later, after 1965, as BARTD increased is staffing capability, more and more alternatives came before the staff and Board for decisions. According to Dahms, "More accruately, PBTB presented its studies directly to the Board without staff involvement."[1] Hence, not only did the staff not participate heavily in the early years in the formulation of final alternatives, they did not even have a serious review function regarding alternatives. The relationship was directly between the consultants and the Board.

In return for assuming the responsibility of contract management, PBTB received a total compensation amounting to nearly $142 million through July 1, 1972. (The Composite Report and the Retainer Agreement cited an expected $47 million fee for engineering services.) This fee covered expenses and profits for design and management of construction contracts totaling, at that time, $1.43 billion. Opinions are sharply divided over

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[1] McDonald & Smart, Inc. interview with L. Dahms, Acting General Manager, BARTD, July 31, 1975.

the appropriateness of this size of fee. This fee amounted to approximately 10.5% of total construction costs for the basic BART system and compensation of 6.2% of the total construction costs for the transbay tube and approaches.[1]

In addition to the inability of the staff to control the Joint Venture, a second issue revolved around the Retainer Agreement's approach to Joint Venture Compensation. The Retainer Agreement provided for reimbursement of direct costs, and overhead and profit as a percentage of direct labor costs. Virtually no ceiling was placed on allowable reimbursable costs, nor was definition of reimbursable costs particularly explicit. An alternative might have been cost plus fixed fee or a percentage of estimated total construction contract costs. Either of the latter two approaches could have been structured flexibly to permit possible increases for enlarged scope, negotiated on an annual basis. Certainly, this latter provision is essential, insofar as many of the cost overruns of the BART project were related to redesign, re-engineering, or unanticipated community demands. The engineers, on the other hand, undoubtedly felt the uncertainties associated with the costs of construction and the design problems behooved a cost plus percentage fee basis for implementation of BART. Thus, the retainer agreement was structured upon an overhead allowance and fee factor of 125% of direct labor wages and salaries incurred in the central office, 90% of direct labor wages and salaries incurred in the field offices, and 10% on subcontracts.

At BARTD, there is support for the type of agreement which was negotiated with the Joint Venture. The total fee was not excessive in the context of engineering contracts for highways, for example, which can typically run over 20% of total construction costs. Furthermore, given the uncertainties of the design and engineering requirements, a fixed fee contract may well have constrained the contribution the Joint Venture was willing to make. According to Dahms, "The basic problem was not the agreement, but the inability to manage PBTB."

3. The Construction Schedules: Costs and Delays

There was never any doubt of the magnitude of the cost of constructing a 71-mile rapid transit system in a metropolitan area. In fact, the dimensions of such an undertaking

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[1] McDonald & Smart, Inc. interview with John Everson, Managing Partner, PBTB.

were overwhelming even to the engineering estimators, according to PBHM engineers working with the Joint Venture. The system, as proposed, was unprecedented; few of the characteristics had been fully engineered even in other industrial applications. The uncertainty associated with costs was substantially recognized by BARTD and the Joint Venture.

There were few key decisions which uniquely affected the increased costs of building BART. Many events conspired to cause the cost escalations, and numerous decisions were made to cope with these overrruns -- decisions which did have some impact on BART's ultimate configuration. Thus, the significant decisions were ones of reaction, as well as the foreclosing of alternatives.

The BART management acknowledges that the construction schedule was rarely delayed by unforeseen construction problems. The primary delays were caused by the District being unable to reach agreement with local jurisdictions or by management decisions on the part of the staff, particularly in response to available financial resources. As far as system construction (as opposed to equipment construction) is concerned, the dilemma which BARTD faced was that each delay imposed a considerable cost in addition to inflation, and the availability of funds was limited.

a. Initial Estimates of the Composite Report

The estimates of the Composite Report, which determined the size of the bond issue in 1962, provided a conscientous attempt to place a price on the still-unspecified system. It was recognized when the estimates were prepared in 1960 that scheduling would have an impact on total cost, given the tendency for inflation, appreciated value on rights-of-way, and the phased capacity of the construction industry to assimilate the work.

The summary of estimated construction costs attempted to include most conceivable expenses associated with the new system: track and structures, stations, yards and shops, electrification, train control, utility relocation, engineering charges, right-of-way acquisition, contingencies and, notably, inflation. The latter category was not a line item normally discovered in conventional engineering estimates. The projected 8 1/2 year construction schedule, however, behooved some consideration of inflationary pressures and the Joint Venture decided to separate inflation from its normal category of contingencies. Nearly 17% of total construction cost was allowed for inflation. Approximately 10% was permitted for contingencies.

The role of estimating the future costs was delegated within the Joint Venture to Bechtel, which already had a full estimating department within San Francisco. Several sources in the Joint Venture have alluded to the difficulties of this arrangement. Bechtel Corporation, as a large engineering firm accustomed to dealing in a highly competitive market for private contracts, was loathe to permit sufficient interaction between the estimators and the Parsons, Brinckerhoff personnel who had experience in transit systems. Bechtel chose to hold the sources and worksheets for estimates very closely; even the operations people within the Joint Venture who wished to confirm the appropriateness of estimates frequently were denined access to the worksheets. Even in the presentation of the engineering study to the District Board in May, 1960, the members of the Joint Venture were not advised of the cost estimates until half-way through the presentation when a Bechtel messenger arrived with the final estimate during the Bechtel partner's presentation.[1]

Although there is no indicated that costs were consciously underestimated, when engineering costs approached $792 million, the stimulus to estimate further all of the potential costs associated with the system -- amenities such as station design, landscaping, and predictable but unspecified engineering studies -- was diminished. "We weren't looking for additional expenses at that point," one involved engineer has stated, "although we were vaguely aware other costs might exist."

b. Discovering Cost Realities

It would be three years before the District would fully accept that the Composite Report's estimates were inadequate. The potential construction cost overruns and the costs of design improvements -- as well as their implications for the District's financial situation -- were reviewed less critically partially by the confidence which repeated successful bond sales promoted, particularly as the District's large cash balances from bond sales earned revenue in excess of interest requirements.

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[1] McDonald & Smart, Inc. interview with Harry Moses, op.cit.

Although the Composite Report estimates of cost allowed for inflation, based on a separate historical cost trend curve for each of the major categories of work, dramatic escalation in Bay Area construction costs were evident by 1965. Inflation averaged 2.8% per year between 1960 and the end of 1964. In 1965, the cost escalation rate leaped to 6% (the Engineering News Record construction costs index for San Francisco actually registered an inflation rate as high as 8% in 1965). Thus, by 1966, the full inflation allowance in the initial cost estimates had been consumed and $17 million worth of the contingency allowances had been absorbed by increasing construction costs. Additionally, labor costs were increasing at as much as 11% to 12% per year.

Inflationary pressures were exacerbated by a second unforeseen force -- the Vietnam War's absorption of heavy construction resources. By 1965, the buildup in Vietnam was gaining momentum and heavy engineering contractors were fully committed in the construction of the infrastructure for military activities in Indochina. A serious shortage of laborers in certain construction crafts was experienced in the Western United States, particularly in the Bay Area. Naturally, the same demand for construction materials for the war effort was providing much of the inflationary pressure. As a result of this demand for construction resources, many contractors were withdrawing from bidding on domestic public works projects.

By 1965, the bidding patterns of contractors seemed to indicate that the contractors were becoming more particular on which projects they chose to bid. Contingency and profit margins included in bids were increasing; furthermore, one contractor indicated it was necessary to plan on operating on a premium overtime basis in order to attract and hold labor necessary for project completion. Thus, events beyond BARTD's control, for the most part beyond reasonable expectations of the estimators in 1960, were causing construction costs to soar beyond projections. In 1966, BARTD noted that some 30% of heavy construction was labor-related, and those costs were then rising at a rate of more than 11% per year. Some 55% of each job was material and equipment, with costs increasing at an annual rate of 3%. The remainder of the job was primarily contractors' markup which also was increased at a rate of 3%-5% per year. These rates were well in excess of the initial estimates for inflation.

By mid-1965, after the year-end audit, concern over the inadequacy of previous engineering cost estimates was increasing. A chronology of the action of the engineers, the staff, and the Board, summarized in Table IV-1, indicates the events related to this concern. At BARTD's express stipulation, cost control procedures were imposed upon the Joint Venture, perhaps too late.

The early years, 1962-1965, witnessed substantial investigation of design and engineering alternatives and options, many of which were not ultimately pursued. In the case of BARTD, extending a dormant technology, this research and development was unavoidable; nonetheless, inevitable and often unpredictable costs would be incurred.

The costs associated with redesign of stations, relocation of stations and routes, and the provision of amenities, as well as the costs of alternate studies associated with these issues were not budgeted. Although BARTD and the Joint Venture acknowledged that the engineering of operational equipment still was to be developed subsequent to the bond election (the final determination on dual-rail steel on steel fixed guideway was not officially made until 1964), they both held the misconception that station and route decisions were fully defined in the plan presented to the voters -- that community participation during the planning process was adequate to gain expeditious agreements and only acquisition of the right-of-way was necessary. This proved a costly misconception.

The lack of a total comprehension of the costs of implementing a rapid transit system, based to some extent on the absence of communication between operational engineers, planners, construction engineers and estimators, was responsible for a significant portion of the cost escalations.

On the other hand, considerable criticism has been levied upon the Joint Venture's management of the project after 1962 when Bechtel assumed the role of project management and control.

Some sources at BARTD indicated the problems which occurred between 1965 and 1967 were a result of the PBTB team losing key managers. Several responsible sources formerly within PBTB, however, indicate a total lack of respect for the management capability of the Bechtel organization which was by then the managing partner. By 1967, according to these sources, Bechtel was managing in much the manner it originally had estimated the project, minimizing the interaction with the planners and engineers representing the other partners of the Joint Venture. As a result, few Parsons, Brinckerhoff or Tudor personnel remained in the Joint Venture head office by 1967, partially from a sense of frustration toward the Bechtel management and partially due to the frustration of underutilization. This management problem merely exacerbated the issue of costs exceeding estimates.

TABLE IV-1

CHRONOLOGY OF ACTION RELATED TO
INCREASED COST BY STAFF AND BOARD

Date	Action	BART Staff or Engineers	BART Board
May, 1962	Cost estimates prepared in Composite Report on 1960 base. 1. Applied 20% for inflation from historic trends. 2. Applied 10% for unforeseen contingencies. 3. Project time schedule.		Approved
December 10, 1963	General Obligation Bonds limited to 15% of assessed valuation.		Approved
September 10, 1964	Engineering cost analysis submitted to Board outlining potential impact of inflation and discussing cost limitations on items not considered in Composite Report.	PBTB BART	Report to Board
December 4, 1964	Review of engineering program status and cost analysis.	PBTB BART	Report to Board
May 13, 1965	First warning of financial implications of delays relative to consideration of alternatives (estimated $10 million).	PBTB; Peter Vandersloot's Interim Report to BART Board	Report to Board
June 9, 1965	General Manager directed Development and Operations to prepare estimate on project costs.	BART Development and Operations	
June 10, 1965	PBTB engineering budget and utility relocation budget for six-month period beginning July 1, 1965.		Approved
July 7, 1965	General Manager instituted with PBTB a stringent system of cost control, a program of cost reduction and a monthly revision of cost projection.	BART, PBTB	

Table IV-1, Continued

Date	Action	BART Staff or Engineers	BART Board
July 27, 1965	General Manager advised by Development and Operations that cost reductions amounting to approximately $40 million had been discussed at the PBTB Board of Consultant's meeting on July 15, 1965	BART, PBTB	
August 16,	PBTB furnished June cost projection pointing out alarming trend in use of available funds for engineering and construction. The report (after taking into account the $40 million cost reduction) indicated that there was less than $10 million remaining in contingency.	PBTB report to Director of Development and Operations	
August 20, 1965	Meeting of PBTB engineers and architects with District staff where cost control was emphasized and need to keep expenditures within limits of voter-approved financing.	PBTB, District Staff	
October 18, 1965	PBTB August Cost Report reflected only $5 million contingency remaining.	PBTB report to Director of Development and Operations	
October 25, 1965	General Manager review with Engineering Committee the status of project costs.		Report to Board
October 27, 1965	General Manager reviewed with Finance Committee the status of project costs.		Report to Board
October 28, 1965	General Manager reviewed individually with Directors the status of project costs.		Report to Board
November 30, 1965	General Manager assigned cost control responsibility to Director of Development and Operations.	Development and Operations	
December 9, 1965	PBTB September Cost Report showed only $5 million of contingency remaining.	PBTB report to Director of Development and Operations	

Table IV-1, Continued

Date	Action	or Engineers	BART Board
December 10, 1965	PBTB October Cost Report showed $11 million contingency after providing $79 million for engineering. The report specifically did not reflect possible cost rise as the result of the Oakland bid.	PBTB report to Director of Development and Operations	
December 20, 1965	Engineering Committee recommended rejection of K001 bid and redesign to maximize competition. Reviewed reasons for high bid. Recommendation to Board of Directors that bids on T0011 Transbay Tube be accepted.		Report to Board
December 29, 1965	PBTB November Cost Report contained no forecast.	PBTB	
January 12, 1966	Engineering Committee reviewed alternate plans for K001 bid.		Report to Board
January 20, 1966	(Page 2) "Memorandum re: Rapid Transit Financing" of January, 1966 called attention of the Directors to 18-month delay in expenditures compared to Composite Report, page 35. "Potential Federal Financial Assistance for Rapid Transit."		Report to Board
January 25, 27, 28, 1966	Projected Cost Evaluation Report by PBTB projected cost of system under various levels of inflation and different alternatives reviewed by Finance Committee and Board. These included cost overruns if Oakland K001 bid was accepted or rejected.		Reports to Board
February 11, 1966	PBTB December Cost Report forecast $985 million for GOB with inclusion of $76 million contingency.	PBTB	

Table IV-1, Continued

Date	Action	BART Staff or Engineers	BART Board
	Various letters regarding cost control investigations:		
June 14, 1965	Engineering management costs	PBTB	
July 9, 1965	Project costs	PBTB	
July 16, 1965	Cost control	PBTB	
July 23, 1965	Construction cost reduction analysis	PBTB	
August 13, 1965	Cost control program	BART	
August 30, 1965	Project construction cost reduction analysis	BART	
December 20, 1965	Engineering and management services	PBTB	
January 19, 1966	Strengthened control and estimating procedure	PBTB	

Source: BARTD response to Legislative Analyst's Office, February 24, 1966.

Recognition of impending financial problems occurred late in 1965. Cost control measures were implemented following the annual audit for the year ending June 30, 1965, which revealed the seriousness of the premature drawdown of funds. The District's General Manager assigned to the Department of Development and Operations, as of November 30, 1965, responsibility for cost control over Joint Venture engineering activities and contract administration. Arthur Young & Company, the District's accountants, was engaged later that year to implement a cost control system for the staff. This effort reversed the previous practice in which merely general budgetary control was exercised by the District, by means of review and approval of the Joint Venture's 6 months' budgets.

c. Changes in Design

Inflation was not alone as a source of escalation for the cost of BART. In 1962, the Joint Venture knew what they intended to do: the intention of the system was fully characterized in both "Regional Rapid Transit" and the Composite Report. What was less certain was how to do it.

Within the limits of capital funds available, it was the Board's policy to authorize and approve improvements to the system in the light of the latest technology of transit design and operation and to consider changes in design plans which would contribute to the aesthetics of the system and the appeal to riders.[1] This proved a fairly generous policy, particularly in the absence of strict cost control, since many of the improvements were the result of costly studies added to the incremental costs of the improvements. This policy of developing the most attractive possible system for its riders was considered instrumental to any attempt to affect modal split. In conjunction with inflation, however, it drew heavily, and prematurely, from engineering funds.

By 1966, systemwide changes had resulted in an increase of at least $86 million (at the 1960 price level, ignoring inflation) as a result of additional scope. These changes are summarized in Table IV-2. A number of these changes clearly reflect better knowledge of the ultimate design of the system. On the other hand, recognition of the problem of engineering the system should have occurred prior to the Composite Report, augmenting the contingency fund in order to accommodate new technology improvements.

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[1] Answers to questions posed by Mr. L. D. Dahms, then assistant to the Legislative Analyst, on March 2, 1966.

TABLE IV-2

SYSTEMWIDE CHANGES

		1960 Cost Basis $ Millions
1.	Tunneled Subway has been used in lieu of cut and cover construction in downtown areas to minimize traffic disruption in important streets. Extensive soil and earthquake investigations indicated use of metallic lining materials for subway tunnels. Favorable quotations for segmented steel lining materials as opposed to cast iron dictated the selection of steel liners. Subsequent investigation has indicated the probable requirement for compressed air tunneling for deeper tunnels in Oakland, Mission Street, and Market Street subways.	4
2.	Subway Stations are longer, wider, and deeper than specified in the Composite Report. This results from the use of center platform design, more strategically located entrances, increased mezzanine headroom, additional space for service mechanical and electrical equipment and adjustment to accommodate tunneled line. Outer Market Street and West Portal streetcar stations have been decreased in length resulting in some decrease in this sector.	15
3.	Additional Escalators have been provided in subway and aerial stations to make vertical transportation more convenient and efficient. The Composite Report design provided one escalator at each aerial station and did not provide escalators between subway mezzanines and the street.	2
4.	Station Completion work including mechanical and electrical service systems, ventilation systems, and architectural finish, which was indicated to be a functional type in the Composite Report, has been improved to provide more attractive facilities for the public. Quantities of work have increased with the increased size of subway stations.	22
5.	Train Control concepts have been developed to a greater degree of sophistication than those provided in the Composite Report.	2
6.	Landscaping has been added in lieu of the erosion control provided in the Composite Report.	6
7.	Track Gauge has been increased form the standard to 5'-6" to permit use of lightweight vehicles with reduced operating cost.	2

Table IV-2, Continued

	1960 Cost Basis $ Millions
8. Fare Collection System has been changed from a cash system to a fully automated system.	3
9. Traffic Control specified in agreements with cities along the rapid transit routes has been more extensive than contemplated in the Composite Report.	5
10. Electrification cost has been reduced based on improved technology and equipment.	(17)
11. Yards and Shops have been relocated to the line locations in lieu of the central location at the Oakland Mole as contemplated in the Composite Report. Maintenance of Way Facility in Oakland has been added.	3
12. Track has been changed from the concepts used in the Composite Report. Retaining rail has been deleted except in sharp radius curves. Support system on structures has been redesigned and rail weight has increased by about 20%.	5
13. Rapid Transit line location and ancillary construction changes have been made from the system contemplated in the Composite Report. Subway line length has increased in Oakland, as a result of relocation of the Oakland Wye and subway portals, adding to cost. Greater use of at-grade construction has been made resulting in a reduction in cost. Ancillary construction, such as street reconstruction, grade separations and utility handling have increased over that contemplated in the Composite Report resulting in a major increase. Tunneled line has decreased in length reducing cost and right-of-way cost has decreased a a result of various alignment changes. The net cost of various alignment changes is	14
14. Engineering and Management Services costs have increased reflecting the revisions in system design and construction scope outlined above. Also, special engineering services beyond those contemplated in the Composite Report have been undertaken, including the study, preliminary design, and cost evaluation of many items which are not now included in the current project scope.	17
15. California Division of Highways engineering and construction management costs are higher than that contemplated in the Composite Report.	3
Total System Improvements	86

Source: Parsons, Brinckerhoff-Tudor-Bechtel, March 20, 1967.

Since 1966, system changes have continued to have an impact on available financial resources. By 1975, expenses paid from the general construction fund (which was initially funded by the general obligation bonds) had increased $66 million over the 1966 reestimate. This increase reflects unanticipated expenses for construction (largely inflationary, except for elevator installation), increased Joint Venture fees ($23 million in additional expenses not programmed in 1966), the costs of agency agreements -- many of which were not anticipated -- inflated land values, and, most significantly, pre-full revenue operating expenses, security, maintenance, and startup costs (an increase of $65 million).

d. Costs of Design Changes

No single decision was responsible for adding unusual engineering costs to system expense, although the policy of permitting exploration of engineering alternatives and accommodating community demands abetted the tendency. Responsiveness to community demands is treated subsequently; here, however, we can itemize some of the engineering expenses, in addition to design improvements, which results in premature drawdown of funds.

Route location engineering was underfunded from the start. Not only was additional work required in making special alternative location studies in the communities of Richmond, Berkeley, Oakland, San Francisco, Hayward, Albany, and Lafayette, but extensive route location surveys also were required in support of unanticipated proposals for joint use of freeway corridors in Southern Alameda County and Central Contra Costa County. As with all massive public works projects developed during the 1960's, there was considerable demand for public participation. Thus considerable expense was related to participation in public hearings on BARTD planning and implementation issues held at the request of local authorities.

Conceptual work and predesign studies not originally contemplated as a Joint Venture function also expanded the scope of effort beyond that contained in the Composite Report. This included the conceptual developmental engineering for fare collection equipment, which was originally presumed to be part of the equipment manufacturer's effort. Additionally, the Joint Venture retained consulting architects to provide detailed conceptual work regarding the development of aesthetic details for the system as a whole. While the latter provided a landmark and the valuable Manual of Architectural Standards for BART, it was a $370,000 expense not provided for in the Composite Report.

The development of alternative construction methods and the obtaining of rights-of-way entry permits to accomplish soil investigations were further examples of additional scope.

Finally, certain predesign efforts which the Joint Venture accomplished were not part of the original estimates yet, in BART's mind, were a part of a turn-key transit system. These included, for instance, system computer programming, train operation simulation programming, and the design for the District's central control shortwave radio system.

The scope of architectural design was increased substantially over the Composite Report's estimate because of the unique treatment and special consideration for aesthetics which was given to each station as well as other components of the system. The Composite Report set out station design configurations based on competitive utilization of standard features throughout the system. Instead, BARTD made extensive use of separate architectural firms, which resulted in an estimated $3.5 million over earlier projections. The expense of individual design elements included conducting engineering studies, both architectural and structural, which were applicable only to single locations. The evaluation of incorporating train screens, ventilation equipment, and additional escalators were among these studies.

Additional unanticipated costs relate to such areas as surveying, transit vehicle development, engineering (including models), coordination with the Division of Highways, systems operation support and, notably, staff support to the District. This latter category included negotiating and servicing BARTD labor stabilization agreements, assisting District right-of-way activities, providing assistance in public hearings, and assistance in establishing accounting, purchasing, and other system procedures.

e. The Costs of Community Acceptance

A key decision in terms of system design and system expense was the policy of the Board to work closely with local communities in order to accommodate their demands concerning route and

station location and alignment of BART facilities within their communities. In preparing the engineering plan contained in the Composite Report, it was the policy of the Board of Directors to have the District and Joint Venture staffs work closely with the engineering and planning departments of the counties within the District so that each jurisdiction's individual views could be taken into account in developing the plan for a regional rapid transit system. Following the bond election on November 6, 1962, it was the policy of the Board to authorize the expenditure of engineering funds for special studies in response to the requests of individual communities.

Although the District was capable of making unilateral design decisions, local communities retained leverage in their dealings with BARTD since formal agreements were required from each community before BARTD could begin construction. This process of reaching agreement often involved painstaking negotiations over the number of amenities BARTD would finance within the community. Many of the amenities which BARTD did finally provide were not considered in the early cost estimates for the system.

Eventually, 15 miles of the 71-mile system were to be rerouted from their original plan, and sixteen of thirty-four stations would be relocated at community insistence. To date, BARTD has executed 166 agreements, 96 with cities, 10 with counties, 15 with special districts, 34 with railroads, and 11 with the State Division of Highways. The costs of this process was substantial in two terms: time and direct cost. The cost of time was particularly substantial, given the rates of inflation which accrued during schedule delays. Considerable refinement and preliminary work became necessary to gain public acceptance of the system, locally, even after final location and acquisition of right-of-way occurred. This was counter to the basic assumption that work could commence immediately, and hence resulted in substantial delays compared to the original schedules. Agency agreements funded out of the general construction fund alone totaled $82 million. An additional $80 million worth of projects based upon community or agency demands were funded largely by federal assistance.[1] These direct costs were augmented by the inflationary expense which the delays caused by evaluating, approving, or rejecting potential improvements.

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1 SFBARTD Comparative Data Report, January 31, 1975.

The nature of delay caused by public or community action can be illustrated in just a few examples. The taxpayers' suit against the District bond election filed in November, 1962 provided a highly visible challenge which caused a 6-month delay. The suit was filed November 29, 1962 and settled, in BARTD's favor, June 10, 1963. During the time of the legal action, an injunction prevented BARTD from disbursing funds to the Joint Venture or committing to construction. The cost of that delay was computed by BARTD at nearly $185,000 of staff expense plus $12 million inflation cost. Intangible costs associated with that delay were the costs of reassembling the engineering team which was getting ready to begin work in November. Although the latter expense has been mentioned repeatedly, it was reduced in magnitude by the decision of the joint venture to continue work during the lawsuit based on its confidence that the lawsuit would be settled in BARTD's favor. The Joint Venture incurred approximatley $250,000 of expenses which were later honored as reimbursable by the District.[1]

In downtown San Francisco, fourteen citizens advisory groups raised questions concerning BARTD facilities planned in the City. Over the course of 16 to 20 months, BARTD sought an agreement on station mezzanine extensions, station locations, depth of BART structure below the ground, separate utility chases, the width of sidewalks, the development of plazas, the lengths of Muni platforms, and location of station entrances, all seeking to satisfy the citizens advisory groups that land use or traffic ciruclation patterns in downtown San Francisco would not be adversely affected.[2] The inflation costs associated with the delay these negotiations incurred have been estimated at $6.5 million, with the cost of staff work estimated at $1.1 million. Additionally, of course, one must take account of the costs of the betterments which were accepted subsequent to agreements. In downtown Oakland, similar discussions caused a delay of 8 months and an associated inflation cost of nearly $1 million.

One of the more highly publicized controversies between BARTD and the local community occurred in Berkeley. In "Regional Rapid Transit," the entire route alignment through Berkeley was aerial. Subsequent to that report and prior to the Composite Report, Berkeley planners proposed a modification to the section of BART which would be within the Berkeley city limits, moving the alignment and placing a portion of it underground. In the joint venture's final planning between 1959 and 1962, the engineering consultants agreed to place the central portion of the line (about 1 mile) underground. In local hearings, this plan was accepted by Berkeley, although considerable disillusionment with the aerial structure was expressed.

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[1] McDonald & Smart, Inc. interview with Jack Everson, PBTB.

[2] BART Response to Senator Nejedly's Questions Concerning the San Francisco Bay Area Rapid District District, Oakland, California, BARTD Office of Research, February 3, 1972.

In 1963, a new mayor was elected in Berkeley, Wallace Johnson, who felt strongly that BART should be placed underground through Berkeley, primarily because the aerial structure was viewed as having a blighting influence, creating a psychological barrier between blacks and whites (since the street down which the alignment runs is more or less the border between the black and white neighborhoods of the city), having a detrimental impact on businesses along its route, and being aesthetically unattractive. A committee of the City Council, headed by Mayor Johnson, was appointed; and, in the spring of 1964, it came up with a proposal calling for the sale of "tax allocation bonds," $6.2 million of which would be earmarked for construction of additional subway alignment. The scheme would call for the city to purchase the right-of-way under urban renewal programs; bonds would be paid off from income from the sale of these properties, the value of which presumably would be greatly increased by the BART construction.

The City Council committee concluded that only a border-to-border subway would raise the property values along the right-of-way sufficiently to permit tax increment funds to pay for the subway. Based on this determination, the city requested BARTD to provide an estimate of the additional costs of total subway construction.

This was the beginning of a continuing exchange over the estimated cost of Berkeley's request. BARTD's engineers' preliminary estimate of the incremental cost of placing the route underground was $21 million. Berkeley's engineers, on the other hand, adamantly defended an estimate of $10 million for realigning the route underground. Berkeley estimated it could raise $6.2 million from the tax allocation bonds and had received a HUD capital grant of $4.7 million to assist in covering the remainder. During the course of over twenty meetings of the BARTD Board of Directors and monthly staff discussions, the Joint Venture engineers and the Berkeley City Council argued their respective estimates, which were important to the implementation of the undergrounding. While Berkeley was willing to pay the incremental cost, BARTD required that financing to cover the entire amount of their estimate be earmarked prior to construction.

On September 11, 1964, the BARTD Board announced its decision. It rejected Berkeley's request for an all-subway system, although the rejection was couched in terms which permitted negotiations to be pursued. Quiet negotiations carried on between Mayor Johnson and Adrian Falk, Chairman of the BARTD Board, resulted in an agreement on October 22, setting up a procedure authorizing BARTD to call for bids on the aerial

section in four parts of the city and on subways in two shorter extensions on either side of the central station (which the city could finance from available resources). This did not foreclose the option of extending the subway the whole length of the city, although that consideration was held in abeyance until adequate financing was arranged. Furthermore, the two short subway extensions would at least provide reliable cost estimates for the entire length.

Following the opening of bids, which came to an estimated $7.1 million for the two shorter extensions, the joint venture estimated that the total subway cost would be $25 million. The Berkeley City Council then decided to offer the voters of Berkeley a choice between the shorter or longer subway extensions. The city asked BARTD to hold an election containing three propositions: first, to establish a special district within the BART District in which a bond election could be held; second, to approve a bond issue in that special district for $2.4 million, the difference between the subway bids and the HUD grant; or, third, to approve a bond issue of $20.5 million to cover (with the HUD grant) BARTD's estimate of the construction cost of placing the entire route underground through Berkeley.

A citizens committee was established in support of the proposition for the longer Berkeley subway. Members of the City Council strongly backed -- and even led -- the citizens committee in a campaign to approve the larger bond issue. It was a strong campaign which rode the crest of much anti-BART sentiment, encouraged by the San Francisco Chronicle's vitriolic campaign against the District. Endorsement of the committee's position on the larger bond issue was received from the full spectrum of citizen and political organizations, from the conservative Berkeley Citizens United to the radical Committee for New Politics. Even groups who opposed rapid transit supported the referendum, perhaps as a means of placing BARTD in the adversary role.

The election was held on October 5, 1966, two years after the agreement between Mayor Johnson and Adrian Falk. The approval of the larger bond issue was overwhelming -- 82% favorable. Thus, in the most dramatic confrontation between BARTD and the community, BARTD's planning was reversed, although at community expense rather than at BARTD expense.

While BARTD did not agree with the psychological and aesthetic reasons for rejecting the aerial alignment, its basic defense of its earlier plan was based on the additional cost of placing

the route underground. Berkeley's bond issue satisfied the financial concern of additional cost for improvements, but it did not cover the inflationary increment to BARTD's share. The subway dispute had caused a significant delay in the timing of BART's construction.[1]

This was not the only delay in the Berkeley segment of the Richmond line. The Mayor and City Council had agreed on station designs in which both the northern and southern Berkeley stations would be partially above ground. The design of the Ashby station, the southernmost, included a 700-foot long, 5-foot high surface skylight, which permitted natural light into the underground subway station but created a surface barrier along its length. In the area surrounding the station, however, the route more or less divides the black and white neighborhoods. Thus, the issue of BART dividing the neighborhoods, an issue raised against the aerial structure, resurfaced.

In mid-December, 1967, Ronald Dellums, then a Berkeley City Councilman, decided to take the design of the station to court, arguing that the understanding of the voters at the time of the referendum had been that the entire line through Berkeley, including the stations, was to be underground. The case was decided in May, 1968 (months after bids were to have been opened for the earlier design) in favor of placing the entire station underground. The entire process of design and construction needed to start again. In this case, BARTD argued, justifiably, that both the Mayor and the City Council of Berkeley had previously approved the established design, and that this should provide BARTD with the local authority to proceed with engineering and construction. BARTD considered it unreasonable to be required to make a change which they estimated would add up to $2.5 million to the station. The court's decision, however, was binding.

While few of the responses to community action were as dramatic as that of Berkeley, nonetheless they had an impact both on schedule and cost. In Richmond, agreement on station location, yard size, vehicle underpasses, pedestrian overpasses, and station site development caused a 13-month delay in schedule. In Concord, agreement over the structure and Chabot

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[1]The bids for the Berkeley subway were opened at the end of May, 1968, and, of note, the bid of the successful contractor was $12.5 million, much closer to the Berkeley estimate than to the Joint Venture's.

Canyon delayed the schedule 4 months, and agreement over traffic circulation at the station and utility relocation delayed the station facility construction 5 months. In San Leandro, agremeent was reached 6 months behind schedule; in Alameda County, 8 months behind schedule; and in Hayward, 13 months behind schedule.

The process of coming to an agreement with the local communities and gaining interaction with citizens groups and local government are necessary components of the planning for a rapid transit system. At the time of BART's planning, however, the length of time necessary to reach agreement was totally unforeseen. With the acceptance of the Composite Report, it was believed that agreements with local communities could be handled expeditiously, and that most route location and design issues already had been resolved at the local level. After the bond issue, however, many of the local communities realized the significance of BART and its immediacy. Their serious attention was suddenly brought to bear on the question of BART's contribution, responsibility, and potential for the local community.

These costs cannot be ignored when imposing a rapid transit system on an area. However, community interaction must be considered explicitly in scheduling a rapid transit system; consideration of the costs must be in terms of the phasing of construction to respond to community demands as well as the expense of improvements. The failure of the Joint Venture to consider these costs might be underplayed, since there was little precedent. Nonetheless any future system must consider this interaction an integral part of plan implementation and cost.

f. The Watershed: The Oakland Subway Bid

A fiscal year-end audit in mid-1965 punctuated the concern that costs were running beyond the initial Composite Report estimates, and that drawdown of funds was occurring more rapidly, relative to construction benchmarks, than had been envisioned initially. This concern reached crisis proportion in December, 1965 with the receipt of bids for the Oakland subway between 24th Street and Madison, and the transbay tube.

Throughout 1964 and 1965, construction contracts had come in generally below either the Composite Report preliminary cost estimates or the final engineering estimates prepared subsequent to the bond issue. On the other hand, unscheduled drawdown on funds had been occurring for non-construction activity,

including right-of-way acquisition, engineering, and design expenses. Excluding the Oakland subway and transbay tube bids, the thirteen previous construction contracts had been an average of 14% below the final engineering estimates and 16% below the Composite Report estimates. Thus, concern over construction costs was minimized.

In the case of the Oakland subway, however, the Composite Report had budgeted $26 million. In the final engineering, the cost estimate had increased dramatically to $49 million. While this increase sought to accommodate the inflationary pressures, the full impact of Vietnam-related reduced competition among contractors was further emphasized when only two bids were received on the subway contract on December 3, 1965. The low bid was $61.5 million, a 135% increase over the Composite Report estimate and a 25% increase over the final engineering estimate.

Six days later, the transbay tube bids were opened. The same two construction firms bid on the transbay tube, although Perini Corporation, which came in with a low bid for the Oakland subway, came in high on the transbay tube. The low bid for the tube was nearly $90 million, or 51% above the Composite Report's $59.5 million estimate and some $8 million in excess of the final engineering estimate. The transbay tube bid was alarming, although less immediately critical since the Division of Bay Toll Crossings had agreed to fund the tube from toll revenues on the Bay Bridge. While negotiations were necessary to expand the funding from toll bridge revenues, at least the tube was not funded from the finite bond issue sum available for system construction.

The need for a total reestimate of the original costs for constructing the basic system and the transbay tube was manifest. By July, 1966, the engineers had revised all cost estimates for construction on the basic system and the transbay tube. It was determined that the basic system would experience a cost overrun of $151 million, bringing the total cost of the system to nearly $942 million (later in 1966, this was revised to $992 million). The reestimate indicated a cost overrun on the transbay tube and approaches of $47 million. Thus, by the end of 1966, the BART system was reassessed as a $1.2 billion transit system. Table IV-4 illustrates the relative increase in each category of expense as a result of the July, 1966 reestimate. Sixty percent of the 1966 forecast was credited to inflationary increases, while the remainder was assigned to the increase in scope over initial plans.

Among the policies which the Board adopted subsequent to this reestimate was a strong cost control policy. In the case of the Oakland subway bid, the District permitted both bids for Contract K0011 (the Oakland subway) and repackaged the contract into six smaller contracts. Although construction was delayed 8 months by going out to bid a second time, design modification reduced the cost $3.9 million. More substantial in nature, however, was the impact which the increased competition for the smaller contracts caused in the ultimate bid price. Firms which did not have the size to undertake the entire subway contract were able to bid on the smaller segments of the contract. As a result, the total bid price for the six contracts which comprised a scope of work similar to contract K0011 was $47 million, quite close to the engineers' estimate prior to going to bid.

The new subway bid notwithstanding, there was an immediate need for $150 million in additional financing. The 1966 reestimate had considerable impact on both the subsequent schedule for construction and the costs of remaining elements of the system. The transbay tube contract and the repackaged Oakland subway contracts were signed and construction commenced. From 1967 through 1969, a period of acute financial austerity, contract awards were stretched out as funding became available. This policy of putting out to bid only those contracts which could be fully covered by available resources had particular implications for the rolling stock. The bids for transit vehicles were received in 1967, but since the funds were not available, they remained unopened until 1969. By delaying the order for transit cars from 1967 until 1969, not only were deliveries delayed, but the cost of each car increased from $153,000, estimated in the Composite Report, to $236,000. Undoubtedly, a portion of this escalation must also be attributed to more detailed design specifications. Nonetheless, the inflationary toll was taken on delays.

This provides merely a single example of the cost directly associated with the District's financial constraint. Another example is the contract for electrical substation equipment. As a cost reduction measure, the initial contract was sufficient to build only 60% of full design capacity, or just enough to power an abbreviated fleet of 250 cars.

g. Board Policy on Long-Range Financing

In recognition of the needs for alternate sources of financing, on September 8, 1966 the Board of Directors of BARTD committed itself to building a complete, operable regional rapid transit system fully consistent with the standards that were set in the Composite Report. This commitment was clear; the system which was proposed to the voters in 1962 was the system which would be constructed. This policy position, however, was not adopted without considerable debate.

In order to accomplish this goal, every effort was being made to control and reduce costs, without compromising standards. The District also increased its efforts to gain federal support. Finally, the decision was reached to consider truncating the basic system through phasing construction in those elements of the system which would result in lower patronage requirements. Thus, some 55 miles of the 71-mile system would be completed.

Throughout this period, the assumption was maintained that operating revenues would exceed operating costs, hence funding need only be sought for system completion, not operation. The Board, however, was not alerted to the danger that rolling stock would also have to be externally financed. The General Manager was particularly reluctant to make this concession.

The position the Board stated was that it would make every effort to seek additional funds to complete the system, and only failing that would it consider a deferred program of construction which would complete a smaller system first. With this policy position, quoted below, the District proceeded for two years to pursue state approval of additional tax support and federal funding.

> "In summary, it is possible that additional funds and cost reductions may reasonably be expected to provide the funds necessary to complete a regional system. The federal capital grant funds and additional revenue derived from interest-bearing time deposits may total as much as $100 million according to present estimates. Cost reductions and deferrals could well amount to as much as $50 million.
>
> "Should, however, the District find it impossible to complete the basic System within the limits of available funds, and after taking into account practical deferrals in the program of construction, it contemplates seeking voter approval of a second general obligation bond issue in whatever amount may be necessary. Under existing law, the District may issue general obligation bonds, up to a limit of 15 percent of the assessed valuation of taxable property within the District. Because of the constant growth annually in the value of such taxable property on its assessment rolls, it will be possible by 1969 to issue an additional estimated $68,000,000 in bonds, providing their issuance

is approved by the electorate. If necessary, the District also contemplates requesting the Legislature to amend its enabling act to increase the bonding limit to 20 percent and possibly to modify the voting requirement. Public confidence in the program as expressed when the voters approved the original $792,000,000 bond issue is expected to assure their approval of whatever additional financing is required."[1]

C. Operating System Engineering

The characteristics of BART which facilitated public acceptance of regional transit -- the high technology, advanced state-of-the-art engineering concepts -- also were responsible for considerable concern as the equipment and facilities were placed in operation. Expectations were high for a sophisticated rapid transit system based on new, highly automated technology. From the inception of the Commission in 1953, the public information efforts associated with rapid transit in the Bay Area touted the advanced engineering and associated effectiveness which any proposed system would represent.

The augmented expectations of the public, then, were frustrated as costs soared, delivery schedules were delayed, and performance failed to meet anticipations. The difficulties of a new system would have in meeting performance specifications were recognized early in the history of BART planning. Thus, an approach to evaluate system needs, as well as the solutions to those needs, was devised.

One must realize that the advocates of regional transit in the Bay Area, from the earliest days, possessed a conviction not only of the need but also the form of the solution. Operating characteristics for BART were determined long before technical systems to fulfill them were adapted to BART's use. (Many of the systems were premised upon systems that were operational in different applications, such as aerospace.)

This section reviews the evolution, rather than distinct decision points, of some of these characteristics, and the decision process related to the technical choice of potential operating systems which offered alternatives.

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[1]Policy Statement on Long Range Financing, adopted by the Board of Directors on September 8, 1966.

Before the key decisions related to system engineering were made -- as early as in the 1956 PBHM report, "Regional Rapid Transit" -- a general performance concept of a rapid transit system was conceived with minimum average operating speed of 45 miles per hour and headways as short as 90 seconds. The rapid transit car was conceived as being comfortable, with smooth riding qualities, internal temperature control, adequate ventilation, sealed windows, freedom from fumes, a low internal noise level, and a pleasing appearance. The actual means of fulfilling these standards was not clear at the time they were conceived. But a test and demonstration program, as an essential element in the implementation of the transit system, would provide testing upon which system specifications would be based. The decisions on systems engineering were expected to occur subsequent to this test and demonstration program.

The rapid rail concept itself, as illustrated earlier in this analysis, evolved from the perception of the problem rather than through complete evaluation of alternative transit systems. The system types considered were narrowed to two basic systems: (a) suspended trains, and (b) supported trains. In any case, the rapid transit solution was expected (by its planners) to incorporate the following essential features of a modern rapid transit system:[1]

-- Comfortable seats for 76 passengers per car; wide aisles; large, sealed windows, forced ventilation; and adequate heating.

-- High speed operation with top speeds of at least 70 miles per hour; smooth, rapid acceleration and deceleration to permit average running speeds of 45 miles per hour, including station stops.

-- Modern automatic train control to ensure safety of operation on a minimum headway of 90 seconds. The controls would govern not only the speed of the trains but also would automatically berth and dispatch them at stations. Although the operations would thus be fully automatic, the estimates of operating costs allowed for an attendant to be stationed at the forward end of each train, with control procedures at his command in the event of any emergency or obstruction of the right-of-way, and to perform functions related to passenger information and assistance.

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1 San Francisco Bay Area Rapid Transit Commission Report to the Legislature, December, 1957, pages 74-75.

-- Communication between trains, dispatchers, passenger stations, power directors and substations via a private communications system, including radio telephone.

The source of these specifications is elusive. The early planners and advocates of rapid transit in the Bay Area universally emphasized the instinctive quality of these general standards for rapid transit methods, equipment, and operations. If the problem is defined as congestion or the movement of people into urban centers, and the requirement is to provide rapid transit with relatively high attractiveness compared with the automobile, these general standards "clearly" must be met, at a minimum. Concurrently, these general standards gained authority and acceptability from their reiteration in the deliberations of the Senate Interim Committee on San Francisco Bay Area Rapid Transit Problems (1952-1957) and the San Francisco Bay Area Rapid Transit Commission.

The most compelling early description of the type of rapid transit system necessary to solve the problems of the Bay Area is contained in the Senate Interim Committee's report, "Mass Rapid Transit in the San Francisco Bay Area -- Answer to Traffic Congestion." Included in this early report were remarks by Alfred J. Lundberg, the past president of the American Transit Association, who proposed an "unorthodox system."

In Lundberg's remarks, the system was identified as fast, comfortable, and operating at very close headways. He emphasized that a system which will attract patronage from the automobile must differ radically in three respects from existing commuter systems:

-- The form of trains used;

-- The method of operating the trains; and

-- The method of financing the construction.

Further, he emphasized the need for attractive trains, operating on a headway as short as 40 seconds and at speeds which would approach 65 miles per hour. Acceleration and deceleration would occur at the rate of 3 miles per hour per second. The automatic train control system was described as a "block" system, not unlike the automatic train control system ultimately implemented. The system he described would work on the basis of signals transmitted to the train by magnetic induction, being picked up from the running rails. The automatic train control system would permit the trains to stop at stations automatically, much as automatic elevators do. Lundberg also emphasized that the system would have a centralized train control. Each train would contain one employee in contact with central train control in case of contingencies.

Walter Douglas, of PBHM, arrived at analogous characteristics in the germinal description of an interurban rapid transit system for the Bay Area, "Regional Rapid Transit" (1956). Thus, a consensus was forming among transit planners toward the system concept to be embodied by BART.

Two objectives of the proposed system narrowed the alternatives in most subsequent system design decisions: the system would be faster than automobile travel -- averaging 45 to 50 miles per hour -- and convenient -- operating on short headways up to 90 seconds. These technical attributes, complemented by attractive and comfortable vehicles, were considered essential to luring travelers from their cars or, alternately, into making transit trips which they would not otherwise have made at all.

Fulfillment of these objectives -- speed, convenience, and comfort -- governed the vehicle configurations, system design, and even station location of BART. This section will review the process of reaching technical decisions on transit system components which emerged from a concept and forged an operating system with new and modern dimensions.

The decisions were made in an environment of technical competence. Shaping the system from the visionary concepts was the responsibility of consultants who could rely on their experience as professional transit engineers. In designing a new system, the professionals were supported by the enthusiasm and open-mindedness of first the BART Commission, and later the BARTD Board. New solutions -- automated, aesthetic, dramatic -- were encouraged. Furthermore, during the system design period, the euphoria of a billion dollar system spurred innovation.

The opportunity to provide a truly modern system was available. Thus, consultants provided a solution which offered speed in terms of the fastest trains available and headways at the minimum consistent with safety.

The confidence and experience of professional engineers were often the bases for eliminating alternatives in the early design stages; the Commission's concept of rapid transit does not appear to have been rigorously challenged, although alternatives among fixed guideway systems were subjected to technical evaluation. Yet early conceptual design decisions (such as vehicle capacity) were not necessarily challenged when system implementation began, since many of the design teams who refined the 1956 system between 1959 and 1962 eventually were responsible for final design. (An exception

was route location, which was thoroughly reviewed by a new team in 1963, although the basic routes were not affected.)[1]

In the case of technical decisions which involved advanced systems -- available in other applications perhaps, but not yet operational for transit systems -- a technical test and demonstration program was devised. Appropriately, BART developed general functional criteria which the system was to fulfill, different approaches were evaluated under operating conditions, performance characteristics of all tested equipment, and the lowest responsive production bid was accepted. This approach foreclosed alternatives at two points: first, performance specifications were drawn from systems tested in the program, but were not related to performance capabilities of conventional existing systems. Secondly, the lowest responsive bid policy, required by state law, virtually eliminated District choice of manufacturers.

1. Vehicle and System Characteristics

a. Speed

It seems that there was never any doubt that the system would be fast. In "Regional Rapid Transit," the standard for an interurban rapid transit system was set to equal or improve upon performance of the private automobile on an uncongested highway. Transit speeds, then, were to average at least 45 miles per hour, with top speeds up to 70 miles per hour. PBHM continued to conceive of the system with train speeds of at least 70 miles per hour in preliminary designs documented in the "Composite Report" in 1962. The average speeds, however, were 50 miles per hour. Final train design maximum speed is 80 miles per hour.

The corridors proposed for service were primary existing highway corridors, since the origin-destination surveys documented existing travel patterns. PBHM designed BART as an inter-urban regional express transportation system. Thus, station spacing was devised for providing express service between widely spaced stations where population estimates indicated the demand was apparent. Given the station spacing and the maximum capabilities of existing systems, a top speed of at least 70 miles per hour was deemed necessary and possible to meet the average speed requirements.

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[1] McDonald & Smart, Inc. interview with John Everson, PBTB.

b. Vehicle Size

The vehicle capacity was established as a system design standard in the PBHM report of 1956. At that time, general characteristics of an operating system were developed, based upon equipment in operation elsewhere and optimal standards.

The objective of providing an alternative to the automobile which possessed equal or greater standards of comfort had an immediate impact on proposed vehicle size. In "Regional Rapid Transit," it is determined that: "Seats must be provided for all passengers; and, for acceptable comfort, seat spacing should not be less than 34 inches between seat centers, seat width for two passengers being no less than 40 inches." In addition, "Minimum aisle widths have been established at 28 inches, not only for comfort, but also to insure rapid entraining and detraining."

With these basic specifications, the consultant approached major manufacturers to investigate economical sizes of vehicles which would satisfy the general comfort standards as well as speed requirements.

Among the manufacturers' responses were three designs by the Budd Company, each of different length and capacity. Budd's 68-foot, 76-passenger design was selected as the prototype on the basis of a number of factors, the most important of which were:

- The length permits a favorable ratio of car weight per passenger.

- The length permitted a desirable balance between economy of maintenance and cost per seat and economy in the construction of elevated guideway structures, since the weight per wheel would be relatively light.

- The length permits an interior arrangment which maximizes the number of seats while permitting loading and unloading within a nominal 20-second dwell-time (the time the train is at rest in a station with doors open).

The size specifications varied only slightly from the initial specifications. The final characteristics of the BART cars are 75 feet long for the end cars, with a seating capacity of 72 passengers, and 70 feet long for the intermediate cars, which carry 72 seated passengers.

Our interviews with former project managers at Parsons, Brinckerhoff, Hall and Macdonald have indicated that the size and capacity of the cars were not seriously reevaluated "because it was not necessary." One interviewee reiterated that the same team which was responsible for car size after 1962 had evaluated the size prior to the 1960 Engineering Report, thus had previously reached its conclusions.

c. System Capacity

System capacity was not a precisely defined criterion for system design. Instead, system capacity was a residual characteristic of a system that sought to be convenient, through short headways, and comfortable by providing seating capacity for all passengers, necessitating a long, ten-car train.[1]

Naturally, the BART planners emphasized the high hourly capacity of a rapid transit system, per lane, compared to the 2,500 to 5,000 passengers which each lane of freeway is capable of carrying, depending on auto occupancy and number of buses. "Mass Rapid Transit," the 1953 report of the Senate Interim Committee, identifies the problem as one of moving people, thousands of them. The advantage of modern rapid transit trains, it commented, was their ability to carry 40,000 or even 60,000 persons per hour per track. In its 1956 report, "Regional Rapid Transit," PBHM identifies rapid transit's major role as its ability -- without usurping the amount of land that would be necessary for highway construction -- to carry an hourly capacity of 24,000 to 40,000 passengers per lane (depending on the length of the train and the number of standees).

In the "Composite Report" of 1962, the system capacity had narrowed to 30,000 seated passengers per hour at any given point. This capacity was determined by the specifications of the prototype car which held approximately 76 passengers seated. To avoid the necessity of carrying standees and to meet peak hour demands, the maximum train length was determined to be as long as possible without deterring optimal urban operation. Ten-car trains of approximately 700 feet were considered the maximum train which could be accommodated by a platform in an urban area. Thus, applying train capacity to the 90-second headway objective, the system capacity of 30,000 passengers per hour was determined.[2]

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[1] Interviews with Harry Moses, B.R. Stokes, A.E. Wolf.

[2] Interview with Harry Moses.

The system capacity of 30,000 passengers per hour has frequently been treated as a BART objective rather than a system statistic. It is unlikely, however, that the capacity would ever be reached. There are no present plans to operate the trains on less than 120-second headways, although early plans called for a 90-second headway capability. Furthermore, it is extremely unlikely that travel demand in the BART corridor will ever reach these dimensions. In 1970, peak hour patronage on Bay Bridge buses was 13,030 passengers. An additional 11,800 passengers crossed the Bay Bridge by automobile during that peak hour. Thus, total person trips during the peak hour in BART's most traveled corridor equaled only 24,830 among all modes in 1970.[1]

While travel demand will increase in the Bay Area with economic growth, it is improbable that travel demand would ever reach a volume resulting in 30,000 peak hour passengers on BART alone. Furthermore, there are only five rail transit lines in North America, four in New York City and one in Toronto, where peak hour passengers exceeded 10,500 during the mid-1960's.[2]

The system capacity of 30,000 passengers per hour, then, is an academic determination, not a decision outcome nor system specification.

d. Vehicle Weight

The weight specifications were directly related to the speed standards and the economy of operation. In order to achieve the performance requirements of the system, to minimize power consumption while meeting both acceleration and speed standards, and to minimize the cost of maintenance of the tracks, it was clear from transit engineering experience that the vehicles needed to be lightweight.[3]

Although lightweight cars existed, no other rapid transit system operated on lightweight cars at the speed envisioned for BART. Thus, the development of a lightweight transit vehicle became a major objective for the BART system. While the prototype vehicles from which the specifications were taken -- the vehicle design submitted by Budd Company -- provided for a weight per passenger of approximately 850 pounds, by 1962 the objective was to design a vehicle with an unloaded weight of under 800 pounds per seat. Between 1962 and the point of full specification of the vehicles, the weight requirement had evolved to no more than 800 pounds per foot of vehicle length, with penalties for exceeding this goal.

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[1] Kennedy, 1971, pages 27-32.

[2] Ibid.

[3] PBHM and BART Demonstration Programs, David Hammond.

A direct result of the weight specification was a review of methods to assure transit vehicle stability at high speeds and against the winds experienced in the Bay Area. This decision, then, established the need for an unconventional gauge.

e. Vehicle Design

The vehicle design standards which have gained such favorable visibility for BART were first articulated in the 1953 "Report to the Senate Interim Committee," in which Alfred Lundberg's unorthodox system calls for long, streamlined trains. This appears as first documentation of the concern for design which was more than cosmetic in effect.

In 1956, "Regional Rapid Transit" emphasized the necessity to provide an attractive travel environment in order to compete with the comfort of travel by private automobile. The basic specifications of the system included comfortable seats for all passengers, 76 per car. There were to be wide aisles to permit easy movement within the car and large sealed windows to provide a light and open environment.

BARTD's second employee and the source of its public information program, B. R. Stokes, quickly espoused this concept as an essential one. Stokes was convinced that it would have to come up with an exceptional design to lure commuters off the highway (especially with California's automobile affinity) and into transit. He reasoned that, in an era of luxurious jet transports and silent, comfortable cars, something better than utilitarian vehicles would have to be offered. Walter Douglas, the principal author of "Regional Rapid Transit," shared this conviction.[1] Further, the PBTB "Composite Report" documents this perception of the design of the BART vehicle unambiguously: "Interior as well as exterior appearance of the rapid transit car is attractive."

While this authoritative statement related only to a conceptual prototype, the BARTD pre-election public information program had provided a proliferation of photo renderings of what the ultimate BART system might look like. In all of these renderings, the BART vehicles were futuristic trains, with a definite jet age sleekness and unconventional appearance.

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[1] Interview with B.R. Stokes.

BART interviewed four industrial design firms, three of which reportedly made sober and conventional presentations. The fourth, Sundberg-Ferar made a presentation of designs which tremendously impressed the Board and staff.[1] Sundberg-Ferar, a Detroit design firm, had considerable experience in automotive design; "they know how to design for a moving object," according to a project manager at PBTB.[2] Stokes claimed that the prototype "epitomizes, more than any words can do, our entire philosophy."[3]

Although the design received some adverse comments for being too slick, the general response was extremely favorable. The interiors included padded seats cantilevered from the cars' side walls to increase leg room and result in easier maintenance of the cars' interiors. The seats are upholstered and the floors carpeted.

Not unlike many of the planning and engineering decisions, the design of the cars should have been coordinated with operationally-experienced personnel. As designed, the window in the trainman's cab is on the right side, since it was assumed all platforms would be on the outside of the tracks, giving the trainman the opportunity to sit on the right side in motion and still observe boarding passengers. This design detail was not changed when inside platforms were introduced. Furthermore, the side windows were fixed, since vehicle designers -- who, at an early point, blocked half the cab with train control equipment -- did not expect operators to be responsible for observing boarding and alighting.

Despite the general acceptance of the cars' appearance, one element of the initial design proved to be technically controversial. A feature of the prototype which was specified in the "Manual of Architectural Standards" was a detachable control pod which would house the train control equipment and the attendants who would be carried on each end of the train. All transit cars were to be designed to receive the pod.

The control pod was eventually eliminated from the train design for two primarily technical reasons. First, the difficulties of providing safe coupling of the electric systems between the control pod and the transit car to which it was attached were excessive. Secondly, and probably more importantly, the labor expenses of attaching and detaching the wheel-less pod each time the length of the train was changed, at least four times per day, were considered both complicated and inefficient.

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[1] "BART: The Bay Takes . . ." Architectural Forum, 1966, pages 44-45.

[2] Interview with John Everson, PBQD, December 30, 1974.

[3] "BART: The Bay Takes . . .," op.cit.

The final car designs resulted in two types of cars, "A" cars with an integral attendant's car, and "B" cars which comprise the center cars. While this solution accommodated the wiring problems of the detachable control pod, the complications in the frequent procedure of changing the length of the trains according to travel demand during the course of the day have not been simplified. While the location of "B" cars is interchangeable within the train, type "A" cars must be the first and last of each train. Thus, the train must change its length in a yard where the end cars can maneuver. According to BART's Director of Transportation, there was no alternative which would not have involved additional cost. Every car could not be equipped with control equipment while maintaining the important design profile. Any effort at sleek design would require yard changes of car lengths; only yard facilities at the end of each line would have made the process practical.

A second controversial feature of the interior design of the cars, which otherwise are noted for their comfort and quiet, was the Board's decision not to include straps for standing passengers. However, the car supplier had considered hand-holds for standing passengers; fortunately, this consideration resulted in seatback handles and ceiling plates for stanchions should such modifications ever be made to the cars. The capacity of the system was designed to accommodate all passengers in seats. This optimism denied the reality of even unforeseen heavy patronage, let alone the lack of capacity due to high maintenance requirements.

2. Test and Demonstration Program

While Lundberg's concept of the unorthodox system may have begun to narrow the focus of the general characteristics of a rapid transit system nine years before the "Composite Report," he felt that all necessary devices for the rapid transit system he envisioned either existed within the field or were operational in other fields.

BART was to prove the inadequacy of this optimism. While the components of BART's system may well have been in use in other fields, BART's test and demonstration program proved a considerable technical effort was required in order to adapt these components for use in either a state-of-the-art rapid transit system, or to improve the state-of-the-art.

The engineering consultants recognized from the start the need for testing certain design elements prior to the final specifications for the equipment and structure. As early as the 1956 PBHM report, three areas of investigation for a test and demonstration program were recommended: noise control, rubber tires, and the application of alternating current. The comprehensiveness of the demonstration program expanded in early 1963 to include additional areas of inquiries concerning untried technological approaches.

The objective of the demonstration program was to identify the best possible equipment and systems to satisfy BART's operational and aesthetic goals. Necessity for the program was evident to the consulting joint venture who was admittedly uncertain about precise operational specifications. Although BART, the engineers, and the public knew what they wanted BART to do, none was certain how it would be done. The demonstration program was intended to assure that technical system selection was based on evaluation of diverse technical alternatives and informed judgment of potential technical performance.

The expectations of the test program were understandably high. BART's general manager, B. R. Stokes, exclaimed, "We will have to make up in months for a half century lag in rapid transit research."[1] In fact, the crash program, scheduled for a three-year period, permitted a working partnership among BART, numerous manufacturers, and the transportation industry in general. An indication of the program's participation is contained in Figure IV-3.

The outcome of the evaluation process was PBTB's performance specification of a system. The initial input was a set of criteria and operational performance parameters against which manufacturers were invited to propose demonstration projects. A limited number of projects were selected for demonstration on the 4.5 mile Mount Diablo test track, between the cities of Concord and Walnut Creek. Subsequent to evaluation of the demonstration projects, PBTB, who operated the test track for BART, developed system performance specifications based upon the desired attributes of all the test projects. These performance specifications, in lieu of hardware or equipment specifications which would describe the system's configuration, were the basis for production bids. State laws then required BART to accept the lowest responsive bid.

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[1] Friedlander, "BART's Hardware: From Bolts to Computers."

FIGURE IV-3

TEST PROGRAM: LABORATORY CAR EQUIPMENT

FIRST TEST SERIES	SECOND TEST SERIES
CAR A Power: 4,160 volts ac Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks and suspension (air): Budd Electric propulsion system: Westinghouse Electric Brakes (air-disk): Westinghouse Brake & Signal Gears: Dana-Spicer Couplers: Westinghouse Air Brake, Ohio Brass Door operators (electric): Vapor	**CAR A** Power: 4,160 volts ac Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks and suspension (air): Budd Electric propulsion system: Louis Allis Brakes (air-disk): Westinghouse Brake & Signal Bears: Dana-Spicer Couplers: Westinghouse Air Brake, Ohio Brass Door operators (electric): Vapor
CAR B Power: 1,000 volts dc Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks and suspension (hydraulic): LeTourneau-Westinghouse Electric propulsion system: Westinghouse Electric Brakes (electric tread): Westinghouse Air Brake Gears: LeTourneau-Westinghouse Couplers: Waugh Equipment, Westinghouse Air Brake Door operators (electric): Vapor	**CAR B** Power: 4,160 volts ac Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks suspension (hanger-coil): Pullman-Standard Electric propulsion system: Westinghouse Electric Brakes (electric tread): Westinghouse Air Brake Gears: Westinghouse Electric Couplers: Waugh Equipment, Westinghouse Air Brake Door operators (electric): Vapor
CAR C Power: 1,000 volts dc Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks and suspension (air coil): General Steel Industries Electric propulsion system: General Electric Brakes (air tread): Westinghouse Air Brake Gears: General Electric Couplers: Ohio Brass, Waugh Equipment Door operators (pneumatic): Vapor	**CAR C** Power: 4,160 volts ac Automatic train control systems: General Electric, General Railway Signal, Westinghouse Air Brake, Westinghouse Electric Trucks and suspension (air coil): LFM-Atchison Electric propulsion system: Garrett Brakes (hydraulic disk): B. F. Goodrich Gears: Dana-Spicer Couplers: Ohio Brass, Waugh Equipment Door operators: Vapor

OTHER PARTICIPANTS

DC power distribution: Alcoa, Cleveland Crane & Engineering, H. K. Porter, Ringsdorff Carbon
AC power distribution: I-T-E Circuit Breaker, H. K. Porter
Current collectors: Cleveland Crane & Engineering, Garrett, Ohio Brass, H. K. Porter, St. Louis Car
Miscellaneous: Adams & Westlake, American Seating, Corning Glass, Elicon-National, Exide, KW Battery, Safety Electrical Equipment, U.S. Steel, Vapor, Waugh Equipment

Source: Gordon D. Friedlander, "BART's Hardware: From Bolts to Computers," IEEE Spectrum, Volume 9, No. 9-11, September, October, November, 1972, page 63.

The test program provided a technically credible evaluation of alternative system components for BART's meeting its preliminary performance criteria. None of our research has indicated that the influences of industrial and commercial interests, or other political and economic considerations, directly affected the elimination of alternative system designs. Technical considerations dominated.

Since none of our research indicated that others should have been included, our investigation focused on nine technical areas:

- Transit vehicle stability and wind resistance
- Sound and vibration reduction
- Propulsion equipment and power supply
- Transit vehicle trucks
- Automatic train controls
- Laboratory cars
- Automatic fare collection
- Test track facilities
- Subway construction methods

The demonstration program effectively permitted development of performance specifications based upon evaluation of alternatives and a basis of technical knowledge. But it failed to include full testing and evaluation of prototype systems built by the manufacturers selected for system production.

It was expected that the manufacturers would conduct prototype testing. When BART finally supplemented the test and demonstration program with the prototype vehicle testing, neither the finances nor the schedule could accommodate the full requirements for this testing.

According to John Beckett, former BART Director, Bechtel attempted to promote a true prototype testing for the cars, but the BARTD staff and Board did not approve it. By the time the necessity was apparent, the car contract was so far behind schedule it was not possible to formulate a prototype system test independent of a production run. Coordination between the ATC development and vehicle systems, an essential prototypal testing, did not occur.

The solutions to the technical problems of advanced technology are discovered through testing and operational experience. The gist of a major criticism of the decision process which resulted in implementation of an Automatic Train Control (ATC) system which was not fully operational is the failure to extend the principles of the demonstration program to the ultimate system designs.

Holger Hjorstvang, a former systems engineer with BARTD, and Willard Wattenburg, an electronics expert, cited inadequate prior testing as a shortcoming of the development of the implemented ATC system.[1] Furthermore, Wattenburg charged that, "BART ignored all tested and proven designs and bought a paper design."[2] In essence, this is true, and "tested and proven designs" include conventional systems as well as the designs demonstrated at the test track.

The Mount Diablo test track provided the facilities for full-scale testing of the innovative systems inherent in, if not essential to, the BART concept. Nonetheless, the intent of the demonstration program was to investigate alternative approaches to transit hardware and systems and to derive from those demonstrations the performance specifications for BART's operating systems. The demonstration program did not include the testing of prototype operating systems (although production cars were eventually tested as incomplete prototypes of the entire system) or the evaluation of production equipment, with the exception of the fare collection system. Thus, the ATC system design was derived from alternate systems tested at the Mount Diablo test track in 1965 and 1966, although the production design by Westinghouse did not undergo the same test track evaluation. Neither BART nor the Federal Government was willing to fund rigorous and objective evaluation of the individual systems destined for BART operations until it was too late.

Stokes recognized the potential an expanded demonstration program might have had, particularly as inadequacies became apparent during the implementation of the new systems. In October, 1973, Stokes explained to the Assembly Committee on Transportation:

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[1] Friedlander, op.cit.

[2] Wattenberg, op.cit.

"For example, it has been contended that for all innovative benefit to the BART system, our three-year test track system might have done more to anticipate and divert some of our present operating problems had it been continued longer. However, original capital limitations dictated that the test track not be a separate facility, but eventually be double duty as mainline trackage. Even with that provision, the test track could have been operating for several more productive years had not the last increment of Federal demonstration grant support run out in mid-1968."

Nonetheless, the Housing and Home Finance Administration (HHFA) was willing to provide a margin of financial assistance. The Federal Government -- with the highly convincing advocacy of Adrian Falk, B. R. Stokes, and members of the California Congressional delegation -- recognized the potential implications, nationally, for the advances in rapid transit technology which might emerge from a project to test and evaluate new technical concepts in the field of rapid transit. As a result, the Federal Government's first grant to mass transit ever provided two-thirds of the initial cost of the testing element of the demonstration program. Subsequently, two additional grants were received expanding and extending the demonstration project, while a fourth grant was received to provide for prototypes of the revenue vehicles as complete systems.

In total, however, the Department of Housing and Urban Development, formerly HHFA, would cover only $7.8 million of the $28 million overall demonstration program costs.

In 1963, this was an unprecedented commitment to mass rapid transit. This nascent effort, however, was not sufficient. In fact, it has been estimated that additional unrecovered research and development costs borne by the manufacturers during the test and demonstration program equaled the Federal and BART share.[1] Effectively, this would reduce the Federal contribution to the research and evaluation of new transit technology to less than 15% -- a bargain for the Federal Government and a burden to BARTD.

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[1] McDonald & Smart, Inc. interview with B.R. Stokes, December 5, 1974.

The decision environment for system selection was intentionally circumscribed by technical evaluation. The demonstration program reflected an attitude, however, which may have narrowed the scope of choice rather than broadening it. From the beginning of serious planning for a regional rapid transit system, the solution to transit needs was defined in terms of an extremely modern, highly-automated system. The BART staff and Board were even convinced that only a system which espoused new technology would gain public acceptance, at the polls as well as in patronage.

The demonstration program, representing a search for new solutions, set the tenor of the engineering consultants' attitudes. BART engineering may have suffered from the aura of new technology and advanced system design, for that pretense may have eliminated serious review of conventional solutions to system design.

The concept of the test and demonstration program necessarily results in the development of new equipment which may or may not exceed the capability of conventional and proven equipment. Performance criteria were established on the basis of test designs. The process focus thus lost the overall perspective of the system requirements. When no demonstrated system performed exceptionally in response to the general functional criteria it was to fulfill, the criteria themselves might have been reviewed, particularly in the context of adapting imaginatively existing system designs.

This preoccupation with innovation has frequently been the claim of critics who consider BART an expensive, glamorous, but only superficially effective solution to the transportation problem in the Bay Area. The purpose of the test and demonstration program was to evaluate potential improvements in transportation systems in order to justify their introduction in lieu of proven technology. These critics would contend that the test and demonstration program became an end rather than a means, and encouraged performance specifications based upon demonstrated but not proven technological models. Conventional alternatives were not always considered.

Two criticisms of the automatic train control system relate to this decision process. Dr. Wattenburg has repeatedly criticized BART for over-dependence on the computer[1] and for the District's unwarranted selection of a design on the basis that it was "space age and computer controlled."

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[1]Friedlander, "Bigger Bugs," 1973, pages 32-37.

The same criticism has been levied by Holger Hjorstvang, who stated that he considered BART's ATC system to be unnecessarily complex, and it would have been wiser to use more conventional control systems used in other transit lines.[1]

These criticisms document the potential danger in a decision to develop an unorthodox system. The visionary focus of the early civic leaders and transportation planners and the success of the public information efforts had created an expectation of successful new systems.

The test program approach, which was integral to the development of a truly modern rapid transit system since the conceptual beginnings of BART engineering, provided an effective opportunity for technical evaluation and cooperation in extending the state-of-the-art. On the other hand, while the system design decisions were made on the basis of technical criteria, the process made a passive participant of BART in the decision-making. The selection process did not reevaluate the general functional criteria to which the test system manufacturers responded at all, let alone accomplish that reevaluation prior to specifying performance criteria. Thus, the participating manufacturers, as a dysfunctional group, responded only to the original criteria and preempted the ultimate determination of system capabilities.

Thus, PBTB evaluated the alternative demonstration system and, on technical grounds, developed performance criteria from the most favorable aspects of each test model. If the test models did not accomplish a necessary function of the system, either through the inadequacy of the general specifications or through the manufacturers' misperception of those needs, this functional capability might have been lost. Conversely, technical capabilities in excess of system requirements might surface in demonstration testing and become perpetuated in performance specification, when they are unnecessary and increase the complexity, and hence uncertainty, of implementation.

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[1] Ibid.

The performance specification approach also runs the risk actually encountered: definition is difficult in terms sufficiently precise for contract supervision. Finally, without testing a prototype against operational requirements, in isolation as well as integrated into the total system, control over the capabilities of the production system are lost. Although the evaluation of prototype cars aimed at pretesting the system, it occurred out of proper sequence (car production was underway) and was an addition to the implementation schedule rather than an integral part. Again, this resulted in technological over-confidence.

Finally, the legislative requirement that the District accept the lowest responsive bid perpetuated BART's passive role in the decision process. Thus, decision-making in the system design was made on sheer technical considerations through a process with channeled momentum toward innovation.

Key system engineering decisions which stemmed from the demonstration program are discussed in detail in this section. Some engineering concepts evaluated at the test track, however, were non-controversial in their technical selection and merely deserve mention. Included among these were the comprehensive sound reduction program, a high priority assignment to accomodate planners' early recognition of the importance of a quiet system for perceived comfort. The design of the concrete track bed and the development of the "second pour" technique to ensure the track circuit integrity while fastening rails to the concrete track bed were also important products of the demonstration program. Similarly, the testing and selection of rail fasteners to attach rails to concrete beds was a technical product of this program. Finally, subway construction methods were explored, as part of the program, in preparation for drilling two tubes through the Berkeley Hills. All of these decisions benefited from the testing of alternatives against technical criteria.

a. Automatic Train Control

Automatic train control had been represented as an integral element of a rapid transit system as early as 1953. It was considered essential in all of the engineering studies as a result of the system specifications for 90-second headways, 70 to 80 mile per hour top speeds, and long trains. The

imprecise nature of human reaction was considered intolerable for successful and continuous operation of the system. In order to maintain consistent 90-second headways, the variations in motorman operations were unacceptable.

The automatic train control system also became a necessity as a result of the route location in Oakland. The Oakland Wye essentially represented the merging of three separate routes. In the engineering decision allowing three routes to share a single corridor, automatic train control became essential to adjusting train arrivals and departures at the interlocking merger while maintaining minimum headways through the transbay tube.

Thus, the decision to develop an ATC was based on headway specifications, which may not be met, and route engineering which required ATC to meet the short headway. Our research has revealed no serious consideration of a non-automated or conventional control system.

There are three elements to the automatic train control system required by the planned BART system. The "automatic train operation" generally substitutes for the work traditionally done by the motormen and door guard, controlling the propulsion and braking functions, as well as door opening at stations. "Line supervision" enforces schedules and routes of individual trains system-wide, maintaining a centralized traffic control function for the full system. "Train protection" controls operations against collisions, overspeed, and movement through switches -- operational responsibilities related traditionally to signal systems.

The automatic train control system, plagued with operational difficulties today, may have been the victim of an aura of technological advance which surrounded the planning effort of BART. Early objectives for the automatic train control system -- contained in the Senate Interim Committee's report, "Mass Rapid Transit," of 1953 -- was for a system analogous to the cab signal control system designed by General Railway Signal Company for the Key System. Likened very simply to a horizontal elevator, the automatic train control system was perceived as one which could stop trains automatically at stations, and automatically open and close transit vehicle doors safely, all without a motorman. "No new invention is needed for completely automatic operation. All necessary devices now exist and are in actual use in other fields."

The cost estimates for alternative train operation which were contained in "Regional Rapid Transit" in 1956 were also based on using contemporary operational electronic equipment. This basis for cost estimation may have been for expedition rather than a belief that conventional systems might fulfill the automatic train control function. By 1962, the engineering report for BART indicates that the automatic train operation system conceived for BART is not presently operational, although the basic designs are deemed feasible. "The development of a completely new rapid transit system offers the opportunity to incorporate these new concepts to the fullest possible degree."[1]

The mood of excitement over advancing the state of transportation art was dominant both at BART and at the Joint Venture. "We knew we were designing a system which had never existed before. No one knew how to implement our design concepts in 1962," commented Stokes. "But we knew we were designing a successful system to compete with the automobile."[2]

The demonstration program received more than a dozen train control system concepts, of which four were chosen for installation and demonstration on the test track. Westinghouse Electric Company, General Electric Company, General Railway System Company, and Westinghouse Air Brake Company all participated in the demonstration program, augmented by a demonstration from Philco Corporation following the conclusion of the formal testing period. All four demonstrations were deemed successful, apparently confirming the validity of the performance requirements. Although the ATC demonstrations occupied the majority of the demonstration time on Mount Diablo test track, the General Manager considered all of the test programs to have been truncated for lack of continuing Federal assistance.

The performance specifications ultimately developed for the operational system could have been fulfilled by any of the systems demonstrated or by a combination of the concepts. Nonetheless, the test report summary states that all four ATC systems "successfully met the intents of the general functional requirements for ATC and the BART system. No single ATC system was significantly outstanding."[3] In March, 1967, Westinghouse Electric Company received the contract for

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[1] PBTB Engineering Report, June, 1961, page 16.

[2] Interview with B.R. Stokes, December 5, 1974.

[3] SFBARTD Demonstration Project, Automatic Train Control, page 2-1.

the ATC system, competing against several other firms including some who had not participated in the demonstration program. Westinghouse's $26 million bid for a design based on a system that had been demonstrated at the test track, but not by Westinghouse, was the lowest responsive bid and earned the contract.

Subsequent events have raised serious doubts with the CPUC about the adequacy of the ATC system, as implemented. During the operational tests by BART before revenue service was initiated, the ATC system failed to meet certification standards. This failure related to the system's inability to detect a train dead on the tracks. However, this may not have been so serious a problem as first reported. The duration of the failure is less than one second and results when a thin film of oxidation forms on the track when the system is not operating such as at night or on weekends; the oxidation disrupts the passage of ATC electronic signals which pass through the track. However, the problem occurs only when one single train car is in the signal block and when all of the power is turned off in the car. The basic issue, therefore, is what constitutes continuous train detection. A highly improbable combination of circumstances would have to occur for the problem to arise during revenue service: a single unpowered car on a rusty track. There are no single car trains; the minimum is two, and four-car trains are the shortest used in revenue service.

Although the CPUC authorized commencement of revenue service in September, 1972, it was specified that a "manual block" procedure be used with trains being separated by at least two stations. This manual system was accomplished by having line supervisors telephone ahead to be certain that the track was clear at the following station. A number of iterations have occurred in the process of solving the problems of automatic train control. Ultimate operations will be under control of the basic ATC system as modified by the Sequential Occupancy Release (SOR) system. SOR has been installed on the system, but approval has been postponed until reliability improves and funding problems are resolved. The interim solution, known as the Computer Augmented Block System (CABS) was designed to enforce station spacing using new software and the central control computer and at the same time improve headways.

This determination by the CPUC that the automatic train control system is inadequate for total reliance in full revenue service has had impacts beyond the train control function alone. The initial solution, a manual block system, resulted in headways of approximately 10 minutes. CABS I operation is on 12-minute headways on three routes. This results in overlapping routes or six-minute headways on the Fremont

line, through Oakland, the transbay tube, and on the M line. Full service, which began in early 1975, includes a third line through the tube; scheduled headways are indefinite, but will hopefully be about two minutes. SOR operations will probably limit headways through the tube to about 100 to 120 seconds. Actual headways will be determined by transit vehicle availability.

Discussion of the decisions which had an impact upon production and performance of the ATC has been curtailed by the reluctance of Westinghouse and BARTD officials to comment during the present litigation over ATC contract performance. A residual major issue, however, relates to the quality of coordination and direction from the Joint Venture. Westinghouse contends that various delays in scheduling construction did not permit it to install and test its system in a timely fashion. If BARTD's sporadic loss of dead car detection was to be regarded as a problem, it should have been dealt with much earlier, through a comprehensive testing program under the scrutiny of BARTD, Westingthouse and the PUC. The resolution of these difficulties will apparently be settled in court.

b. Automatic Fare Collection

The concept of an automatic fare collection system was espoused as early as the 1956 "Regional Rapid Transit" report, which noted that the use of turnstiles or some other form of automatic fare collection was clearly superior to the alternative use of human labor as platform, train, or gate collectors. "The extent of the system, the number of collectors required, the high cost of human collection are sufficient to preclude this method in favor of automatic turnstiles."[1]

By 1962, the "Composite Report" had resurrected a form of automatic fare collection system which had been dismissed in the earlier report. This system was based upon a charge account in which the regular passenger inserts his identification card in a turnstile at both entrance and exit from the system and the fare is added to his account. He would then be billed by the central computer. The cash fare customer would purchase a coded card or token which permits entry to the system and exit from the system if the correct fare has been paid.

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[1] PBHM, op.cit., page 15.

The decision to establish fare policy on a schedule of proposed station-to-station fares -- based on distance traveled -- essentially precluded a non-automatic fare collection system. This decision on a fare structure was made by the District prior to 1962, on the basis of equity arguments and in order to best replicate automobile cost relationships. The mileage-related fare policy would be severely handicapped by manual collection procedures because of excessive manpower requirements. On the other hand, simple turnstiles would not adequately accomodate the variables of the mileage fare structure.

The determination of a system was based on the same process as other elements of the demonstration program. The total program consisted of five stages. First, a search and feasibility study was conducted by BART and the consulting engineers, PBTB, to explore the possibilities of collecting a graduated fare and to determine availability of equipment. That effort resulted in the conclusion that it was both desirable and technically feasible, but that the equipment did not exist.

Second, BART solicited proposals and awards engineering design contracts to three manufacturing firms to produce prototype equipment. Third, with HUD assistance, contracts were awarded to four contractors -- Advanced Data Systems Division of Litton Industries, the General Electric Company, and a joint effort by Control Data Corporation and FMC Corporation -- to manufacture, test, and demonstrate three different systems. Although the concepts and hardware were developed independently and differed significantly, the three systems had similar results.

Based on the findings of the demonstration stage, PBTB prepared a performance specification and BART called for competitive bids for the production of fare collection equipment. The basic criteria were:

- For convenience and economic feasibility, the great majority of the passengers would have to operate on a self-service basis.

- The function and operation of the equipment should be easily understood by the passengers.

- The system should convey to the public an impression of simplicity and convenience.

- The system must allow the use of tickets valid for single trips, round-trips. Ideally, there should be one ticket to serve all passengers.

- The system must be secure from abuse by fare evasion, easy ticket duplication or alteration.

- The fare system collection must be flexible to accomodate system expansion, and to adapt readily to changes in patronage in any station. For BART, it is estimated that 75% of the passengers will be commuters. About half of them will pay minimum fares, according to a tentative fare structure. Fares would range from 25¢ to $1.00 per ride. In the year 1975, there would be about 260,000 passengers per average normal work day. While the present BART three county system has 33 stations spread over 75 miles, it may grow to several more counties and more than 100 stations.

- The system must be adaptable to changes in the fare structure.

The performance specifications included the best features from each of the three systems tested. The contract for the manufacture of the system was awarded not to any of the three companies who participated in the testing program, but to IBM Federal Systems Division.

Two general functional criteria highly relevant to transit planning and operations were notably absent from those developed for fare collection. While the system called for adaptability to changes in the fare structure, this was not foreseen to include congestion pricing alternatives. The operational consoles at each entry gate can be reprogrammed for a new fare structure, but it is estimated that it would take an entire day to reprogram the entire system as it is now set up.[1] The automatic fare collection system does not have the capacity to vary the fare structure during the course of the day, providing, for instance, lower fares during the off-peak period. If the fare collection system had been connected to a central computer, this capability would have been realistic.

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[1]McDonald & Smart, Inc. interview with Howard Goode, Department of Planning, BART, December 2, 1974.

A second opportunity which had been intentionally omitted in the initial specification for procurement reasons was the continuous collection of origin and destination patronage data from the information encoded on the tickets. This function and the centralized revenue reporting function could have been prepared on hourly or daily bases by connecting the turnstile/consoles to a central computer. While one of the manufacturer's proposed designs considered in the demonstration program -- that of CDC/FMC -- included a real time processing of fare collection and passenger gate control functions by centrally located general purpose computers, the potential uses of the data processing system beyond the fare collection system were not explored as part of the demonstration project. The versatile programming possibilities of the CDC/FMC data processing system were alluded to, without considering patronage recording, an essential element in planning and scheduling of transit operations.[1] Only later, when operational planning functions were assumed by BARTD personnel were these data collection requirements instituted. The additional contract of nearly three-quarters of a million dollars was executed to implement the data collection function.

An ancillary impact of the automatic fare collection system was the deterrence of this unique fare collection system to the integration of transit operations and fare structures among the operating agencies in the Bay Area. Although the fare structures of the three principal transit operators are each different -- Muni has a flat fare, A.C. Transit has zone fares, and BART has a mileage-related fare -- joint fare or combination fares can be arranged if the processing equipment is sufficiently flexible. While a reduced fare arrangement for feeder services on A.C. Transit has been implemented by BART, the integration of fare collection between the two systems has not. Furthermore, the potential for physical integration or compatibility of the ticketing, given the highly automated and capital intensive BART system, is diminished (although a system is being prepared for demonstration which would use BART-type fare collection on Bay Area buses). The considerations of integration -- or at least coordination -- of operating agencies within the Bay Area was considered in 1967 by the Northern California Transit Demonstration Project. The results of the report were not enthusiastically pursued by any of the participants.[2]

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[1]Although the demonstration project Technical Report Number 2 on automatic fare collection does not list recording of passenger movement and revenue data as a performance standard, this requirement is cited in Hammond's article on the BART demonstration programs. This raises the question of whether the demonstration program strictly followed its purpose and whether the technical reports provide specifications modified to those the demonstration systems were capable of meeting. At least one BART employee interviewed has questioned the integrity of the technical reports emanating from the demonstration program.

[2]McDonald & Smart, Inc. interview with Goode, op.cit.

According to the former General Manager, B.R. Stokes, the pervasive attitude at BART, while fueled by optimism, was one of tolerance toward problems, but reluctance to accept serious problems. Stokes cites the example of IBM as a precursor to the response toward Rohr and Westinghouse:

> "IBM fell flat on its face in the initial design of the automatic fare collection system. We understood that it might not work the first time. But IBM turned around, started over, and spent $20-25 million of its own money on solving the problems. That was part of the concept. We had big corporations -- Rohr, Westinghouse, IBM -- who couldn't afford to fail. We had big corporations who would eventually put it out."

c. Track Gauge

Without increasing the weight of the lightweight vehicle, an apparent solution to increasing the stability of the lightweight car at high speeds is to widen the track gauge. The standard 4'8" gauge of railroads in the United States was deemed inadequate for obtaining the desired lateral stability. The Stanford Research Institute was engaged to submit wider gauge designs to analysis and to perform wind tunnel tests. Factors such as the dimensions, shape, and weight of the proposed vehicle, the velocity of winds in the Bay area, the passenger load distribution in the car, and the anticipated operating speed of the trains were investigated. The technical recommendation, which was adopted, was that the BART vehicle and track system should be designed to a gauge of 5'6". While this decision appeared unconventional given the standard gauge in the United States, the wider gauge of 5'6" was standard in serveral foreign countries.

d. Propulsion Equipment and Power Supply

A paramount priority of the demonstration program was the testing and selection of an optimal electric propulsion system. The program called for a thorough evaluation of all existing or proposed electrical power supply systems, concurrent with propulsion equipment studies, to determine the overall system most suitable to BART requirements. More than twenty feasible concepts were reviewed. Seventeen potential suppliers were contacted, six of whom participated actively in the development program.

The principal distinction between the systems considered was the electrical supply alternative: detailed comparison was conducted between a 1,000 volt dc system and a 4,160 volt, three phase ac system. While the direct-current series motor has been the most widely used for transit purposes, considerable research into the development of an adequate alternating-current system was undertaken.

The advantages of a three phase alternating current system relate to the efficiencies of transporting electricity. All electricity is provided by local utilities as alternating current. The standard dc motors required that the current be rectified to convert the energy to direct current. If this process could be eliminated, more efficient use of alternating current and, hence, reduced energy consumption, could be effected. Furthermore, alternating current transports more efficiently, so that the elimination of inefficiencies in the transportation of the current from the rectifiers to the vehicles would result in additional economies. While the three phase induction motor is an extremely rugged, low maintenance and low cost motor, and its control equipment is simple and of low cost, it is a constant speed machine so that a speed-changing device would have to be developed and interposed between the motor and the wheels. To its advantage, however, alternating current would result in fewer emissions into the ground along the transmission lines, hence lower transmission loss.

Despite these advantages, a major problem related to the technical difficulties of transferring polyphase alternate current from the trackside to the moving transit car. The demonstration program resulted in a conductor which was successful in permitting the ac system to meet basic BART requirements. However, the conductors were extremely complex and were in the configuration of three parallel rails set perpendicular to the ground which effectively created a visual barrier between tracks and a barrier to effective movement of employees in the yards. While the technical complexity of the conductors was an element of the ac system's elimination, the concurrent introduction of solid state rectifying systems considerably lowered the cost of converting ac to dc energy, improving the relative economic characteristics of the 1,000 volt dc system. Thus, the selection of a dc chopper control was a decision made in the process of practical elimination of competing systems.

With the decision to employ direct current as primary power, the choice of propulsion systems in effect was narrowed to that employing dc chopper control. While linear control was the conventional method, the Japanese had perfected a more modern propulsion control of chopper system which resulted in a smoother acceleration time, more efficient operation, and provided the opportunity for power regeneration from dynamic braking.[1]

The location of the contact rail for conveying power to the trains was specified alongside the rails early in the planning process. Underground operation, with restrictive tunnel clearances, plus aesthetics on the surface and elevated guideways, ruled out overhead distribution and pantographs.

The requirement for all cars to have integral propulsion units (one on each axle) was dictated by the acceleration and speed specifications initially associated with BART system planning.

e. Friction Brake Systems

Although the braking function was not originally described as one of the main areas of investigation of the demonstration program, it received serious attention during the test and demonstration. A fundamental safety requirement is the ability to stop the train consistently within a prescribed distance under the most adverse air conditions which can occur. The demands for automatic, accurately positioned stops were unprecedented. For patron convenience, the objective was to consistently berth trains centered at the platform. Performance goals for the braking systems were also severe in terms of energy transfer per unit of time.

Electrical dynamic braking will be utilized. Thus, the propulsion system provides deceleration capability. This is quiet, clean, and involves the least maintenance. Subsequent to deceleration by dynamic braking, hydraulic friction (disk type) brakes bring the train to a stop.

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[1] Hammond, op.cit., pages 635-637 and interview with John Everson, PBQ&D, Project Manager, PBTB, December 30, 1974.

The selection of the appropriate braking system was the result of evaluating seven brake systems, representing various control and force application designs which were chosen for installation in test vehicles. The systems considered were pneumatic tread, pneumatic actuated disk, electrically actuated disk, hydraulically actuated disk, and hydraulically actuated tread.

Each system was tested and evaluated with respect to its control, accuracy, linearity, efficiency, and expected useful life, in addition to its general performance characteristics. Based upon technical evaluation, the integrated braking system was determined as most appropriate for BART.

f. Transit Vehicle Trucks

The BART requirements for transit vehicles which would operate at high speed, require wide gauge tracks to assure the stability of a lightweight system, and perform under automatically controlled operation necessitated a comprehensive demonstration program of transit vehicle truck capabilities. The objective of the investigation was twofold: first, to evaluate truck concepts from the standpoint of safety, ride quality, and maintenance; and, second, to obtain information for use in preparing specifications covering details of construction and spring suspension for the BART system truck. Five custom designed trucks were demonstrated; the test and observations aided in the preparation of specifications for BART system trucks and pointed out certain characteristics pertinent to BART's need for economic operation, safety, speed, and comfort.

3. Transit Vehicle Production

Armed with a backlog of performance specifications from the demonstration program, BART was prepared to invite bids for the construction of 250 transit vehicles. Interacting systems which would provide for performance satisfaction had not been integrated nor scheduled for integration into a prototype vehicle.

Operational difficulties in the development of technologically sophisticated transit equipment in the Northeast Corridor project (the Metroliner) brought to BART's attention the dangers of a manufacturer unable to assure conformance with contract requirements. This problem came to BART's attention as much through contact with Budd Company, the Metroliner vehicle manufacturer, as through the normal channels of awareness of national transit events. Budd suffered tremendous financial difficulties as a result of the problems of implementing the Northeast Corridor project, nearly to the point of withdrawing from transit car manufacturing altogether. Concurrently, Budd was involved with BART, having provided the design specifications adopted for the prototype vehicle used in early planning studies, and having contributed many of the artists' renderings of futuristic vehicles for BARTC's and BARTD's studies.[1]

The dangers inherent in the truncated test and demonstration program at BART were not fully apparent to the staff and consultants until the enormity of the difficulties were witnessed elsewhere. Budd Company's experience with the Metroliner provided BART with the impetus to structure the transit vehicle production program into two parts. The first part would include the engineering, manufacture, testing, and demonstration of prototype cars. In January of 1969, a Federal grant was received in initial support of the prototype program.

Although the objective of the prototype program was to test full system integration, the program necessarily paralleled production of revenue vehicles. The transit vehicle contract for the 250 production cars, as well as the prototypes, was awarded to Rohr Corporation in July, 1968. The first of ten prototype cars was received in July, 1969. The testing of the prototype cars consisted of (a) qualification trials of all major systems and system components applied by various manufacturers, (b) combined prototype systems tests of traction equipment and automatic train operations systems, (c) testing of the completed prototype equipment at the Rohr Corporation's plant facilities, and (d) testing the prototype cars on the BART right-of-way.

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[1] McDonald & Smart, Inc. interviews with Messrs. Wolf, Moses, and Everson.

The primary objective of the prototype test program was to identify problem areas and provide adequate solutions to ensure the production line cars were fully operational and safe. The major deficiencies which showed up in the testing program indicated that extensive retro-fitting, repair, retesting, and car preparation were required before the first production cars could be accepted. Nonetheless, prototype performance appeared sufficiently close to design specifications for Rohr to continue with the second part of the contract, the manufacture and delivery of 250 of the ultimate 450 transit vehicles required.

A key decision related to the purchase of transit vehicles was the Board's policy in 1967 not to commit to any contract for which financing was not available to pay in entirety. Thus, bids for the transit vehicles were not received until 1969, a full two years later than scheduled. This had an immediate impact on price.

The Composite Report originally called for 450 cars, costing between $153,000 and $160,000 each, with initial deliveries in 1967. By the time the order was placed in 1969, financing was available for only 250 cars at $236,000 each. An option for an additional 100 cars at $262,000 average price was let lapse for lack of funds; eventually the next increment of 100 cars would cost $289,000 each with the last 100 cars costing $295,000 each. Thus the $73 million vehicle expense cited in the Composite Report reached a total of $160 million.

Not unlike the Westinghouse ATC contract, many of the key issues related to the production of transit vehicles are matched by the reticence of the key actors, pending resolution of litigation. Reliability problems continue to prevail. Instead of ten percent of revenue cars being down for maintenance, the number of cars available has been running only 50%. With that percentage of cars out of service, service levels are reduced, deterring patronage. The problems encountered by the transit vehicles included both mechanical difficulties with the vehicles and the ATC. The contractors claim, however, that they have met their contractual requirements by achieving actual "mean time between failure" rates which are better than specified in their contracts. This is a serious problem since actual rates are considerably higher than can be tolerated in revenue service. To further exacerbate the situation, the one year warranty on the ATC and cars was expiring faster than the systems were being accepted.

Again, two explicit contentions of the contractor relate to inadequate management and direction by BART and PBTB, and poor maintenance capability at BART.[1] Rohr contends that PBTB supplied inadequate contract specifications and failed to perform overall system design coordination and contract management responsibilities and that these responsibilities were delegated largely to PBTB without BARTD retaining significant capability for critical review and control.

D. Transit Facilities

1. Transit Stations

a. Station Spacing

The spacing between stations, hence the number of stations existing on any route, has implications for the populations served by the transit system as well as the operational characteristics of the system. The greater the distance between stations, naturally, the faster the trains can operate. The decision regarding station spacing, then, becomes a basic determinant of system performance. Station spacing, as with many of the basic system characteristics, was not made within BART's sphere of decisions so much as within the confines of engineering considerations. The Commission report established these basic considerations; without earnest reevaluation, they were considered essential to the vision of a rapid transit scheme and rapid transit had been the clear solution to regional requirements.

In "Regional Rapid Transit," the eventual role of BART, upon which subsequent planning was based, was defined: "This report reveals the broad requirements for regional express transportation and is specifically directed toward the role that rapid transit should play in fulfilling them." By establishing the concept of BART as a regional, express transportation system, alternatives available for station spacing are narrowed considerably. If the system is to be regional rather than local, the stations must serve sub-regional centers rather than local requirements. The implication of this determination is that fewer stations are possible.

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[1] McDonald & Smart interview with Leon Krautz, BART Project Manager, Rohr Industries, May 12, 1975.

As an express system, two alternatives are available: first, a four-track system could be designed to provide both local and express service; second, a two-track system can be designed with stations spaced sufficiently far apart to permit the system to maintain high average speeds. The PBHM report focused on the second alternative. The basis of this focus was involved in the economic concerns of reduced right-of-way requirements in only a secondary way.

The objectives of fast and convenient transportation competing against private automobile trips were stated in 1956: "Inter-urban rapid transit should achieve speeds of 45 miles per hour including station stops, should make delivery within convenient walking distances of the major centers of employ-ment and commerce and should provide service at intervals not exceeding 15 minutes during week day business hours." Further, stations in suburban residential areas "must be accessible over uncongested roads and highways and have ample facilities for parking and for interchange with local facilities." These objectives, which have been challenged by critics of BART but were not challenged among transit planners, define the policy of station spacing.

In the urban areas, stations would be placed within walking distance of concentrations of employment and shopping; spacing would be considerably greater in suburban areas where feeder transit or automobile access was expected. This emphasis on the urban destination of patronage reiterated the concerns of the Senate Interim Committee, which in its "Report on Mass Rapid Transit" of 1953 noted that a rapid transit system must distribute patrons reasonably well over the industrial, financial, and shopping areas of the metropolitan center, but did not concern itself with the distribution within the suburban residential areas.

The system, as defined by the PBHM report of 1956, was rarely challenged within BART. Asking PBQD, in association with Tudor and Bechtel, to implement the system defined by PBHM organizationally foreclosed considerable alteration. The plan represented the concept to be implemented. Throughout the planning process, it remained the blueprint for the final system. Thus, the premises of this 1956 concept were essentially unchallenged from within BART.[1]

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[1] McDonald & Smart, Inc. interview with B.R. Stokes.

On the other hand, Henry K. Norton, a "commuter railroader" of many years who was hired by the Bay Area Council to critique "Regional Rapid Transit," suggested that the system was not rapid enough in the suburban routes between San Francisco and San Jose. Norton strongly recommended express service to bypass some of the fourteen stations planned between San Francisco and San Jose. While this recommendation was relevant to the muted presentations of critical alternatives, it became moot with the withdrawal of San Mateo and the reluctance of Santa Clara.

In an American Society of Civil Engineers report on the PBHM plan, George D. Wittel noted that "the average distance between stations is 2.3 miles, much larger than used in most metropolitan areas. This is done to speed up trains, favor the more distant users, and reduce the station costs, but it must sacrifice patronage from the close-in users who constitute the main source of revenue." This was reiterated by the San Francisco Transportation Committee in 1960 when they advocated a reduction in the station spacing to the order of one-half mile between stations for the urban service area.[1]

Despite these isolated public reviews of the station spacing decisions, the "Composite Report" of 1962 outlined the plan to place the stations with an average space of 2.0 miles. The "Composite Report" identified the transit plan which had evolved from the earlier "Regional Rapid Transit" report after incorporating the input of technical committees in the incorporated areas and counties through which BART would operate.

Interestingly, the public and political demands in these areas were not sufficient to change the service areas in which the stations focused. (Eventually, four of the stations cited as BART stations became Muni streetcar stations and three miles of the system described became the jurisdiction of Muni.) Thus, the average station spacing has increased somewhat in the BART system identified as 71 miles with 33 stations (not including the shell of the unfinished Embarcadero station).

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[1] Report on a Plan for Rapid Transit in San Francisco, 1960, page 34.

Not unlike many of the planning decisions, the decision of station spacing came under criticism after the planning process had been completed. Transportation expert Martin Wohl commented upon the BART system in a series of articles in the San Francisco Chronicle in 1966. Among the criticisms of BART was the fact that the average speeds to be attained by BART, which are 60% to 100% faster than other North American rapid transit systems, were gained at the expense of having stations spaced 70% to 300% farther apart than other systems. While he cited New York, Philadelphia, Boston, and Chicago as having stations less than one mile apart, his argument was undermined by comparing intra-urban systems with the inter-regional system envisioned for BART.[1]

Station spacing also has implications for the profile of patronage.

Off-peak travelers frequently will put up with considerably less walking, inconvenience and waiting than rush-hour commuters. Because of the lack of suitable station spacing in business, shopping and recreational areas, it is reasonable to expect that a higher percentage of BART's daily travel will be made during the four rush hours. While the patronage pattern is not distinctly different from other transit operations, BARTD has been below forecasted patronage during off-peak hours.

Once the regional rapid transit system concept is accepted, the station spacing decision ceases to be an issue. The key decision, then, relates to the role of BART as a regional rapid transit system.

b. Station Location

The primary objective of station location was identified in the 1956 "Regional Rapid Transit" report: "the standards that an inter-urban rapid transit system must maintain in order to compete with the private automobile include achieving average speeds of 45 miles per hour including station stops, making delivery within convenient walking distance of the major centers of employment and commerce, and provide service at intervals not exceeding 15 minutes during weekday business hours."

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[1] Wohl, 1966.

These criteria establish the locations, in essence, of the downtown station facilities both in San Francisco and in Oakland. The station locations in the suburban communities were located with an understanding of the minimum headway which must be maintained (hence, station spacing) and the concentrations of population density which were reflected in the "Regional Rapid Transit" Regional Outline Plan.

All of these initial location decisions for stations were subject to the extensive negotiations with local communities which occurred during the planning periods of 1953-1955 and 1959-1960. Once the bond issue was passed, the negotiations became even more complex. The ultimate location of a station in any community depended upon the agreement of the local jurisdiction. Examples of these negotiations were discussed in Section IV-A.

c. Station Design

The rapid transit vision rarely wavered from a concept of an attractive and extremely modern system which would compete with the automobile. The attitude of the proponents and engineers was simple: "don't look back." Stations, no less than the operating system, represent the system concept to the public and occupy, without relent, a place in the local communities they serve. The early planners recognized the need to make the stations functional and attractive, and with little dispute established a criterion for contemporary design of concrete, glass, and steel, the modern vernacular of the day.

Although the Commission report, "Regional Rapid Transit," was never adopted by the BART District Board of Directors, there is little doubt that it was accepted by the BART staff and their consulting engineers -- who had written it -- as the plan for rapid transit. Thus, general conceptual decisions which shaped the system's profile or image and, which were made by Walter Douglas' PBHM team during 1953-1955 were rarely disputed later. The relevance of related decisions was made in the context of financial constraints rather than the stress of interacting interests.

Naturally, financial constraints impinged badly upon design. So the key decisions relating to station design, or any design, were made in the setting of priorities for diminishing funds. Nonetheless, according to Donn Emmons, the architects, generally speaking, were not excessively constrained. Funds dedicated to architectural design alone ultimately totaled $7 million.

After the Oakland subway bid, one of the considerations for reducing expenditures was to shift to functional finishes in BART stations in lieu of more refined glass or tile. Fortunately, the standards of station design were publicized; retrenchment on station design, if not materials, was publicly difficult.

One proposed design concept contained in the Manual for Architectural Standards which was sacrificed partially for financial reasons, however, was the solid-wall barrier between tracks and the platform. This barrier, called a Train Screen in the Manual of Architectural Standards, was intended to have doors which would open simultaneously with the train doors. It required that the ATC stop the train precisely at each station. The unreliability of the ATC in meeting this requirement was the other contributing factor in its deletion. Nonetheless, despite a substantial number of safety and operational advantages, such as protection against individuals falling on tracks, and the economies of maintaining an enclosed space isolated from the exposure to dirt and wind, as well as temperature control advantages, the screen was eliminated. Savings were estimated at $3.6 million for the barriers and another $5.4 million due to eliminating unnecessary ventilation equipment.

While principles of good design were never abandoned and, to many, the standards for the industry were set by BART, many feel the full potential for BART was not realized. The purpose of BART was to operate a rapid transit system; the implementation of an operational 71-mile rapid transit system was paramount. With limited (though considerable) funds, all non-operating components were bound to suffer.

Issues of design were the subject of highly audible discussions, often in the press. Beyond the physical design issues, the role of designers in the decision-making process -- as designers and planners sensitive to land use and master-planning concerns -- became an issue because of the actors. This section reviews only the design decisions relevant to the stations, however, and documents the process by which design decisions were made within the technical consulting prerogative.

The general characteristics of the transit stations that were outlined in "Regional Rapid Transit" included plans for prototypal surface, elevated, and underground stations. While these plans in no way reduced the alternatives for future station design, the design philosophy toward transit stations, credited to Walter Douglas' aegis, is first defined:

> "Materials for exterior construction are primarily concrete, steel, and glass. Interior and exterior wall treatment, fenestration, floor finishes, and other details conform to contempory architectural practice."[1]

It was on the basis of this philosophy, accepted by Stokes if espoused by Douglas, and considered integral to the rapid transit proposal, that Donn Emmons of Wurster, Bernardi & Emmons was appointed consulting architect to the Joint Venture. This selection occurred after interviewing numerous architects.

Although no specific budget was allowed for landscaping and architectural services in the cost estimates for the bond issue, Emmons headed a design team with responsibility for establishing design criteria for the system. He chose Christopher Alexander, a British architect-mathematician, to lead his research team, which consulted people at all levels of transit, toured the rapid transit systems of Europe, consulted behavioral scientists, and subjected their findings to computer processing.

The output of this design effort was a compilation of some 500 "root" requirements for transit design; while they were neither specifications nor performance standards, they were relational characteristics based on the elements of design which surfaced from multi-disciplinary research for transit facilities and human needs.

This research was scoffed at by the engineering Joint Venture and by BART staff because of its abstractions and lack of mathematical vigor. The types of relationships established as design criteria were non-quantifiable; hence, the engineers did not consider them relevant to the decision-making process: people should not have to sit touching strangers, a passenger should encounter as few obstacles as possible between the time of entry in a system and reaching a seat on the train, there should be no dead-end station corridors where a woman could be trapped, etc. Although this research was dropped after one year and $100,000 expense, Emmons feels a considerable amount of research contained information which was later incorporated in the BART "Manual of Architectural Standards."

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[1] "Regional Rapid Transit," page 90.

The "Manual of Architectural Standards," published in 1965, provided the basic design guidelines for all architectural efforts, including site development, acoustics, color, advertising, concessions, station platforms and cover, etc. It served as a guideline for BART's architectural policies and contained many of the criteria for ultimate station design, e.g., canopies would be at least 280 feet in length and located to provide protection for waiting passengers at the four-car station core; the platform itself would be 700 feet long, capable of handling a full ten-car train.

The Manual established the minimum design standards and physical requirements of the BART system.[1] It was a comprehensive document which provided, for instance, four pages of terse functional and design criteria and one page of narrative on "above ground platform shelter." In establishing these physical requirements, some of the architects finally chosen to design BART stations felt confined. Not only did they feel originality was hampered by the requirements which began to define the space, but also by the sketch site planning which preceded their efforts. The first step in the station design procedure involved a station locator who was a design engineer rather than an architect. The locator prepared a rough site development plan, limiting the architect's flexibility.

Design decisions, until the financial crisis required changes in them, were made outside of the public arena, in the drafting room of the architectural consultant and joint venture. They were determined largely through the criteria established in the "Manual of Architectural Standards." This document, much as "Regional Rapid Transit" did for operating systems, foreclosed consideration of dramatic alternatives. Nonetheless, the variations in stations, despite these constraints, and the high standards of functional design and architecture which emerged, document the plausibility of the "Manual" as a design tool and the versatility of architects in circumventing its constraints.

The decision to avoid sterile station design for the architecturally competitive, individually designed stations was the result of an early tour of European stations which

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[1]The Manual of Architectural Standards was only one part of the overall design standard established for BART. Others were civil and structural design criteria and electrical/ mechanical design criteria.

Emmons took with Sprague Thresher, the staff architect at BARTD. The "delightful" qualities of the Stockholm stations, designed by a variety of private architects contrasted severely with the city-designed Berlin stations. Emmons and Thresher convinced BART to hire 14 different architectural firms to design 37 stations. Many of the stations have since won national architectural awards.

Emmons became frustrated, however, because of his need to reach decision-makers through engineers. This process often precluded design and architectural planning considerations from emerging in the recommendations made by the engineering consultants to BART. Furthermore, many of the engineering and structural decisions made by engineers at the lower, working levels eluded Emmons' scrutiny. This frustration, of ad hoc decisions being made independently of design review, was as overbearing as the broader planning questions which clouded Emmons' relationship with BARTD.

This role of architect as a subordinate rather than a partner in the planning process orchestrated by engineers resulted in a highly publicized controversy between Emmons and BART. The issue surfaced as one of whether the designers and architects were to conceptualize or merely serve as cosmeticians of the engineers' work. Stokes' position was clear: "The name of our game is engineering. The engineers have to be in the lead. Ours is a systems approach that brings architecture into all the other concepts."[1] This attitude, particularly as it affected Emmons' sense of BART's responsibility toward master-planning and the architect's role in that responsibility, resulted in Emmons' resignation.

Emmons was concerned that "the routes were planned where the people were, not necessarily where you wanted them to be."[2] He felt the communities were not sufficiently aware of the issues. Members of the joint venture and BART staff who were interviewed, including Douglas and Stokes, spoke disparagingly of Emmons, impatient with his "naivete" that the plan could not be reconceived after 1962. Days after Emmons' resignation, Lawrence Halprin, the landscape architect and planner who was also a consultant, followed suit.

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[1] Architectural Forum, June, 1966, page 46.

[2] McDonald & Smart, Inc. interview with Donn Emmons, Wurster, Bernardi and Emmons, March 4, 1975.

Emmons was not alone in his frustration. The participating architects circulated a petition demanding greater authority for the architectural consultant in the summer of 1960, months before Emmons resigned. This to a small degree, and the press response to a greater degree, resulted in architectural consultants reporting to a higher level in the chain of command. The consulting architect reported directly to the Project Director of the Joint Venture and an independent consulting architect reported to the BART Board of Directors. Furthermore, Emmons' successor, Tallie B. Maule, had responsibilities which included coordination of all design efforts on stations which had been commissioned. This included review of design revisions in response to financial constraints.

Although considerable controversy surrounded the role of architects in the BART implementation process as a result of Emmons' and Halprin's position, our research shows that, although negative comments were made during the design stages, no well-articulated, overall dissatisfaction with the architectural design on the part of community officials or citizens, with the exception of the Ashby station in Berkeley, and the Market Street stations in San Francisco. The controversies in these two locations and the decisions which resolved them, are described elsewhere in this report in greater detail.

2. Guideway Structures

The basic alignment and guideway structures are responsive to rapid transit's need for a grade separated transit to maintain uninterrupted high speeds. Only through a grade separated right-of-way would the proposed system be capable of obtaining the speeds necessary to the proposed performance.

The alternative alignments, naturally, are limited: an elevated structure, a surface or at-grade, alignment, and subway or underground alignment. While the least expensive construction costs for the transit right-of-way itself occurs at grade, in heavily developed areas a surface alignment involves tremendous expense in providing grade crossings for existing roads. On the other hand, the cost of underground construction can only be justified in areas where congestion is so great and development so dense that it virtually prohibits the use of an elevated structure. The alternative for most alignment within suburban or relatively low density urban areas, then, is the elevated structure.

In designing the elevated structure for the supported system, two essential design criteria were established in addition to standard technical considerations. The design would have to be capable of reducing the noise level of train operation in order to minimize the adverse impacts of the system on the communities through which it passed. In addition, the aesthetic appeal of the elevated structure was established with equal priority to technical considerations. These sensitivities toward minimizing adverse impacts of BART on the communities it served, as well as embodying an extremely upbeat design image, have been largely credited to Walter Douglas, who was Principal-in-Charge of the PBHM report. This design concern, while not unadulterated in the engineering-architecture relationship, is one which has been closely associated with BART's system facilities, not only the guideway structures but also the stations and the landscaping.

The intention in routing and designing aerial construction was to provide a minimal silhouette structure; by 1962, the minimum standards acceptable for construction of an elevated structure were streets or areas with a width of 100 feet between building lines. This provides separation of the transit structure from adjacent buildings and results in a light, shadow-free thoroughfare. Because of the physical attractiveness of the I-shaped or hammer-head single pier elevated structure, it was determined by PBHM as an appropriate design as early as 1956. At the same time, reinforced concrete materials were justified on textural grounds as well as engineering grounds.

The 1965 "Manual of Architectural Standards" sets forth specifications and details for the aerial structures. Donn Emmons' hand in the design criteria, developed with Tudor Engineering, resulted in an apparently lightweight structure, with clean lines and minimal shadows. The supports are single, hexagonal columns supporting the two-track guideway.

The acceptance of the design, however, was not uneventful. The result of the architectural consultant's early priorities was the presentation of alternative proposals for the structure, some of which he later claimed were "tongue-in-cheek." The Board's reaction was wrought with debate. Acceptance of Emmons' recommendations occurred only after another consultant, architect-historian John Burchard, reviewed the designs and approved the original scheme. Burchard, a professor of environmental design, was hired as the BART Board's direct advisor on broad matters of environmental quality. Visual design was merely one element.

3. Parking

Parking has been considered an integral part of the concept of an interurban express transportation system since the start. The planning for BART, since "Regional Rapid Transit," accepted the system's dependence on local transit or private automobile for feeder service that it couldn't economically perform itself. Consequently, decisions related to parking were not concerned with whether to provide it, but with how much to provide and, later, whether it should bear a price. These decisions, as with other planning decisions, relied on the concept established in the first PBHM report.

The process of designing BART facilities included considerable negotiation with local communities. Among the agenda items raised were street reroutings and the provision of parking capacity for the BART stations. While these issues were addressed in the process of gaining local agreement on BART plans, in only one case did a local community take a strong position on its parking requirements which was significantly at odds with BART's planning. Daly City submitted its comments on parking requirements in 1968 during a period of final design and construction of the BART stations. For the most part, the initial negotiations resulted in agreements, and the issue of parking inadequacy arose in other communities only after the facilities were in place.

The initial parking capacities, by station, were based on the observed ratios between passengers and parking spaces at stations along Southern Pacific's peninsula line, and recomputed on the basis of passenger potential at each of the stations which a two-stage BART might expect. This totaled under 30,000 stalls in the 1956 report, which rose to 36,000 stalls through reevaluation by the time of the "Composite Report" in 1962.

By 1970, the number of stalls had been reduced to 18,000 at 23 of the 33 neighborhood stations.

The decision to reduce parking capacity was made in the heat of financial duress. By mid-1965, the landscaping of parking lots had suffered the fate of many perceived discretionary expenses (although it would be saved from the use of supplementary grant funds). By 1970, A.E. Wolf would estimate a total capacity of approximately 18,000 automobiles. A somewhat implausible study was cited, indicating only 7% of all BART riders would be in the park-and-ride category.

Local communities have been quick to react to the shortages of parking, particularly as overloads from the free parking areas began to congest the streets of the communities. The response comes from both popular and commercial concerns on economic grounds that BART had created a local problem with little control over its solution because of funding constraints. Furthermore, the decision to reduce parking capacity provided local jurisdictions with the ability to control patronage by pricing parking in the vicinity of stations, e.g., installing parking meters on streets and, hence, increasing the cost of travel.

While BART had initially conceived its parking facilities as a free service in order to avoid any disincentive to taking BART, parking at the Lake Merritt station (and at the Coliseum during events) has had a fee imposed to prevent casual use by non-BART patrons. The lot where a price has been imposed -- a nominal one at best -- is located in an area where commercial or industrial development attracts automobile traffic seeking parking. Despite the precedent pricing of parking, there is continuing concern within BART about the potential impacts parking costs might have on patronage.

Furthermore, a decision made implicitly, if not explicitly, was to consider parking requirements on the basis of the needs of a five-county system, which would extend to Santa Clara and San Mateo counties. With the optimism that stage two of the planned BART system would eventually be built, the parking capacity for Daly City and Fremont was originally designed with an eye toward accommodating local patronage rather than the patronage tributary from the southern counties. Although BART is willing to increase parking capacity in excess of the needs which the present system would have in a full five-county system, financial constraints will continue to be binding. Still, the attitude at BART remains optimistic of system expansion, perhaps to the full five counties.

Once the transit facilities were completed, local communities began to raise the issue of the adequacy of parking facilities. The Assistant General Manager of BART established an ad hoc committee on parking expansion in 1972 to monitor demand for parking, evaluate the predicted usage of the parking facilities, and, if required, to develop a remedial plan. The committee, which clearly was concerned with the impact parking limitations might have on patronage, issued its report in June, 1973. The report acknowledged that the situation is acute at 14 of the 33 stations. Eight of the facilities were used to capacity. The final report of the committee recognizes the commitment BARTD has to provide adequate parking for the travel demands necessary to assure projected patronage levels.

Improved bus feeder service was recommended to solve the problem in some stations while potential expansion was recommended for the remainder, including proposals for the purchase of land for future development and for horizontal or vertical expansion. The priority of the improvements, given the unlikelihood of additional capital bonding authority, will necessarily come from the Federal Government, state government, or local jurisdictions rather than from BARTD. Federal funds have been received for the parking areas at Daly City, South Hayward, and Fremont, although the application for such funds for MacArthur and Walnut Creek stations was disallowed.

4. Yard Location

The decisions concerning maintenance yard location were made on the basis of route location and real estate availability. The light maintenance yards at Richmond and Concord are placed toward the ends of the lines. The main yard, where all heavy maintenance occurs, is located at Hayward largely because of the availability of appropriate real estate.

The decisions on yard locations were notable, according to former PBTB engineers, in that experts in transit operations were not represented at the time the decisions were made. Originally, yards were planned at the end of each line, with a central yard in west Oakland. As system planning proceeded, the chief engineer decided that he did not want a yard in west Oakland because of the difficulty in introducing cars to the system where three lines converge.

In Richmond, there was available territory for a yard, hence it was deemed the appropriate place for the main yard. Local opposition arose, however, on how much yard space could be taken and where it was to be placed. Since it was necessary to begin construction of yards in anticipation of test vehicle deliveries, the delay in Richmond's coming to an agreement forced the District to pursue an alternative.

The Hayward yard was conceptually located in Hayward during the period in 1960 where projected costs had caused the District to truncate the Fremont line at Hayward. At that time, site selection for the Hayward yard occurred for planning purposes; Hayward was favoring locating the yard in its industrial park area since the local community felt it would stimulate growth. When availability of funds was revised and the Hayward line was extended once again

to Fremont, it was no longer possible to change the location of the yard without losing the support of the Hayward community.

The designation of the Hayward yard as the main yard also occurred indirectly when delivery of revenue cars was imminent, it was discovered transportation of the revenue cars from the factory was easier to the Hayward yard than to the Richmond yard. Thus, the Hayward yard, by default, became the main yard.

Not surpisingly, at least two impacts of the yard location decisions have had an effect on the cost of operations. First, the plan for a yard on the west side of the Bay consistently called for the yard to be located in San Mateo, where the topography is more appropriate and the cost of land lower. A yard in San Francisco virtually was precluded from the start. Economic realism and the optimism toward future expansion south in the West Bay militated against a West Bay yard in the planning process. Thus, while there was some consideration given to providing spur tracks at Daly City in response to operational requirements, it would have been exceedingly expensive to construct and would have eliminated patron parking capacity. Without this yard, however, all trains operating on the San Francisco line must return to Hayward to alter their length in response to shifts in demand during the day. This results in excess vehicle mileage, with concomitant operating and maintenance costs, as well as labor costs. BART considers this "deadhead" mileage, however, at only 2% of car mileage, although this mileage results in concomitant operational costs.

While the decision on yard location was influenced more by the withdrawal of San Mateo County than by the decision process itself, difficulties experienced as a result of this yard location were the result of an attitude that BART eventually will serve San Mateo (perhaps spurred by the recurring transit studies in San Mateo which include a BART-like element).

Again, on technical grounds, the train control system made yard location adjacent to a passenger station inadvisable, since it would complicate scheduling. The effect of this technical decision was an increase in labor costs due to the necessity for transporting train personnel by car from the yards to trains in operation whenever a relief crew is scheduled.

5. Landscaping

From the earliest planning periods, Walter Douglas was convinced that local acceptance of a regional rapid transit system through the communities of the Bay Area depended upon presenting a favorable public image. The need for local acceptance of the system inspired many of the design decisions which resulted in BART's noteworthy aesthetics. BART was planned and engineered to avoid the stigmas which conventional railroads had had upon social values and circulation.

Landscaping, however, was one aspect of BART's planning which the District chose not to address immediately. When the first general manager, John Peirce, determined that the electorate would be unwilling to accept a bond issue in excess of $800 million, the engineering Joint Venture's motivation to estimate the costs of nonessential amenities waned. The first-stage system was priced at $792 million in the bond election of 1962. Neither the costs of architectural design nor the costs of landscaping were explicitly treated in that figure, i.e., there was no line item in the budget. Thus, although the intention of landscaping was included in early plans, the funding was not.

Throughout the process of negotiating agreements with the communities along the routes, the question of landscaping was deferred. Although a landscape architect -- Lawrence Halprin -- was employed by the Joint Venture, his role was as much involved in planning and alignment siting as landscaping.

This relationship, in itself, was unsatisfactory to all concerned. The values of siting, and their relationship to neighborhood aesthetics and social values, as presented by Halprin, were annoying even to engineers open-minded toward aesthetics. A definite sense of urgency existed within the engineering staff of the Joint Venture. When the alignment of an aerial structure was questioned by a landscape architect -- a question which, if addressed, would result in a delay and the cost of additional property acquisition-- the engineers refused to accept the recommendations of a subordinate landscape architect. Halprin's concern over this issue, and his difficulties in dealing with the engineers, caused him to resign two days after Donn Emmons resigned over a similar design responsibility issue.

With the assistance of federal funds, however, Halprin was able to effect some extremely enlightened landscaping, including linear parks under the elevated structures in El Cerrito and Albany. The landscaping successes were as indicative of BART's unfulfilled potential as they were accomplishments. It was the determination and impetus of local communities, as much as BART's, which resulted in the implementation of landscaping. The grant advocacy, however, was definitely BART's success.

6. Provisions for the Handicapped[1]

Provisions for the physically handicapped became a serious issue for public works designs in the 1960's, long after the preliminary design criteria were established for BART, but prior to implementation of the system itself. In 1962, Harold Willson, a representative of the Easter Seals Society's Architectural Barriers Committee, contacted BART to introduce them to the idea of implementing a system designed to be useful for the handicapped persons. The basis of Willson's request was the specification of the American Standards Association for making buildings and facilities accessible to the physically handicapped. These standards included specifications for walks, ramps, stairs, restrooms and other facilities, as well as defined the varieties of handicaps which should be accommodated.

By 1964, Willson was advising BART, informally, on matters such as the adequacy of dwell times and the space between trains and platforms for handicapped patronage; while many of BART's design features were adequate for handicapped persons, he advocated additional improvements such as elevators, self-actuating doors, and specially designed restrooms.

BART's well-articulated purpose had always been focused on competing with the automobile to provide interurban transit and to relieve congestion. Neither the socioeconomic implications of BART's service nor the impact on minority group availability had ever been explored as an objective as it would necessarily have been explored in any transit planning in the 1970's. BART, on the other hand, had sought to be responsive to public demands within the constraints of its financial conditions. The result was that it was willing to be responsive toward accommodating the handicapped.

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[1] "BART and the Handicapped," BART Impact Program Working Paper, Robert Levine.

BART's "Manual of Architectural Standards" specifically excluded elevators which would provide the mobility for the handicapped between the street level and either aerial or subway guideways. "Normal circulation through the BART system should be planned so that handicapped patrons, except those in wheelchairs, can move easily to the destination," according to the criteria of Section 1.7(d). BART's chief design engineer, Deane Abordura, was concerned about the economic justification of modifying facilities for the handicapped. On the other hand, A. E. Wolf, PBTB's design engineer, was concerned about the extent to which structures would have to be modified in both the foreseen and unforeseen matters. The economic considerations constrained planning on more than one design feature for the handicapped: While elevators had been ruled out because of their cost, so had the platform screens which would separate the platforms from the tracks. Without these screens, the danger for the blind patron increases considerably.

A public interest campaign was initiated by Willson to herald the rights of the handicapped in BART planning. Through frequent public presentations, he presented his needs for special facilities and suggested a format for suggestions to the Board. The BART Board of Directors received continuous correspondence from civic groups and individuals including the handicapped and members of Congress. In 1966, BART's Architectural Review Committee directed the staff to provide for future installation of elevators in initial station designs. Another two years had to pass, however, before sufficient pressure was brought to bear to place substance in the previous moot resolution concerning future action.

On February 29, 1968, the Board of Directors approved the inclusion of elevators in the system on the stipulation that the funds be available from the source outside the system. Furthermore, those funds must be above and beyond the funds necessary for completion of the entire system. As a result of this resolution, the District requested an additional $7 million from the state to pay for the provision of elevators in BART, an application which supplemented a $144 million request pending before the California Legislature.

At this point, the handicapped were presenting their pleas through two tactics. A demonstration of the handicapped, representing one approach, converged on the construction of a downtown Berkeley BART station. Widespread coverage augmented public awareness of the issue. The BART Board, by now, was increasingly sensitive to public criticism.

On the other hand, Harold Willson and representatives of the Architectural Barriers Committee of the Easter Seals Society joined BART in requesting that Sacramento fund the additional design specifications. This coalition resulted in substantial legislative success, providing effects far beyond BART alone. Chapter 461 of the California Statutes of 1968 established the legal rights of the blind and handicapped to use public facilities and A.B. 7 established the appropriate design criteria which should be met by public facilities.

The legislation specified minor elements of design which had to be accomodated by BART. The Board, however, had declared itself in favor of elevators with the financial stipulation. In March of 1969, the California Legislature authorized the District to issue revenue bonds not to exceed $150 million, with the stipulation that handicapped persons in wheelchairs be provided access to the system.

The vision of the planners and engineers at BART remained one of accommodating, if at all possible, the needs of the community. The feasibility of accommodation, however, was continuously tempered by financial considerations. By 1965, financial concern was as much an element of PBTB's position as it was BART's. After assessment of the financial implications of providing elevators in all BART stations, the Board approved PBTB's recommendation to eliminate the provisions for elevators in ten stations.

The eliminations were based on considerations of construction, design, and the availability of provisions for the handicapped in alternate convenient BART stations.

This decision to provide less than full service for the handicapped resulted in an extremely vocal public reaction among local governments in the area. City councils prepared resolutions, the City of Berkeley prepared a suit against BART, and official positions by the Board of Supervisors of Alameda County and citizen groups throughout the Bay Area finally swayed the Board, who reconsidered their decision and installed elevators in every station.

While full accommodation of the handicapped, including those with sight and hearing impediments, has not been accomplished, some effort is being made to continue to plan to improve the ability of those minority groups to utilize the transit system. In addition, conditions beyond the control of the BART Board have prevented the implementation of elevator service in some of the stations.

The full cost for installing the elevators was estimated to be approximately $8.5 million, a cost borne with reluctance. The decision was made only under public pressure which was sufficient to influence even an appointed Board.

E. Plans and Efforts to Interface with Feeder Transit

Enabling legislation for BART identifies it as an interurban system; it does not preclude it from operating local transit routes as feeder service. Nonetheless, local transit assumes a significant role in BART's success. This was recognized early in the planning for BART when it was foreseen that feeder service at the outlying stations would be as instrumental in developing patronage as would auto travelers who make a modal shift to ride rapid transit.

The difficulties of effecting a true integration of transit services among multiple jurisdiction operators (i.e., Muni, A.C. Transit, and BART) were to be reconciled in a federally funded transit study under the auspices of the Bay Area Transportation Study Commission. In 1967, the consultants Simpson & Curtin were retained for $750,000 to conduct the so-called "Northern California Transportation Demonstration Program." The purpose of the demonstration program was to identify the reconfiguration of transit services in the Bay Area as a consequence of BART.

While this study reviewed the patronage, costs, and revenues associated with public transportation services in the Bay Area, as well as the mechanics of integrating services (e.g., common fare collection equipment), full cooperation on implementation of the study's recommendations among the participants in the study was not achieved. BARTD encouraged implementation of the study's result; Alameda/Contra Costa Transit District (A.C. Transit) was less enthusiastic. Under BARTD's initiative, further study was undertaken under the direction of the Metropolitan Transportation Commission, although coordination still has not been satisfactorily effected between A.C. Transit District and BARTD in the East Bay counties. Concurrently, BARTD undertook a separate study with Muni, recommendations of which have only been partially implemented.

Nonetheless, a transfer procedure between transit systems in the Bay Area has been established. Initially, the cost was shared equally between the agencies, following a BARTD proposal. Presently, however, the transfer policy with both

A.C. Transit and Muni has been supported with federal funds allocated by the Metropolitan Transportation Commission, the regional transportation planning agency. BARTD's position on the sharing of the cost of transfers, even as an allocation of federal funds, has been that transfer availability has not apparently stimulated patronage. Therefore, there is reluctance to subsidize transfers from BARTD revenues.

BARTD has indicated a willingness to investigate means of cooperation among the transit agencies serving BARTD's three-county jurisdiction. There are difficulties inherent in the provision of transportation services in a region by institutionally distinct transit operators, however, with each serving a specific region (whether or not coterminous), frequently operating with a separate mode and each serving its own self-interest. The result is not always one of providing a unified objective of moving people from origin to destination. While BARTD has sponsored and advocated studies which evaluate extensions of local service -- both as a benefit to BARTD's generation of patronage and as essential for local transit service requirements -- given the limited financial resources at BARTD's disposal, it is unlikely implementation of the studies would receive a high priority against competing uses of funds as BARTD brings its existing service up to its full standard of 20-hour, 7-day operations.

While full cooperation with competing but potential complementary modes has not been achieved in existing service areas, there is also a BARTD responsibility for evaluating the need for transit in portions of its District which are presently not served by any existing transit operators. In response to political pressures from portions of the District which were outside of the A.C. Transit District and beyond the immediate service area of existing BARTD trains, BARTD, with federal funding, has investigated the need for local and feeder transit services in the East Bay areas of Contra Costa County, Livermore-Amador Valley, and the tri-cities of Fremont, Newark, and Union City. In portions of these service areas, feeder bus service has been introduced, with BARTD responsible for the grant advocacy which resulted in funding of 32 new express buses to serve these areas. Operating responsibility for this feeder bus service has been assumed by A.C. Transit, which is a bus transit operator, through contractual arrangements. Thus, the potential for integration of local service into regional transit requirements has been presaged.

The alternative of merging the transit districts to fully integrate service remains politically unlikely in the immediate future. One advantage of the original appointed Board of Directors for BARTD was the possibility of appointing a Board which included the elected members of existing

political entities with transit responsibilities, hence integrating the policy direction of the disparate jurisdictions. While this was never a primary purpose in the legislation's mandate of an appointed Board, it did reflect a view toward political integration of transit responsibilities which has not been actively pursued.[1]

[1] McDonald & Smart, Inc. interview with John Beckett.

APPENDIX A

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APPENDIX B

SUPPORTERS AND OPPONENTS OF BART BOND ELECTION, 1962

BUSINESS ORGANIZATIONS

For	Against
dg. Owners & Managers Assn. of S. F.	Byron Chamber of Commerce
F. Council of District Merchants Assn.	El Cerrito Chamber of Commerce
wn Town Assn. of S. F.	Greater Pittsburg Chamber of Commerce
F. Chamber of Commerce	Brentwood Chamber of Commerce
F. Jr. Chamber of Commerce	Albany Chamber of Com. (Bd. of Directors)
n Francisco Real Estate Board	
vermore Jr. Chamber of Commerce	
siness & Property Owners' Assn.	
st Contra Costa Board of Realtors	
ntra Costa Real Estate Board	
lifornia Farm Bureau Federation	
kland Chamber of Commerce, members	
uthern Alameda Board of Realtors	
ntra Costa Home Builders Assn.	
ameda Chamber of Commerce (Bd.ofDir.)	
ameda Jr. Chamber of Commerce	
easant Hill Chamber of Commerce	

CIVIC ORGANIZATIONS

For	Against
y Area Council	Albany Homeowners & Taxpayers Assn.
eater Mission Dist. Citizens Council	Contra Costa Commuters Assn. Bd. of Dir.
nicipal Conference of S. F.	Central Council of Civic Clubs
ght-Ashbury Neighborhood Council	Civic League of Improvement Clubs & Associations
Valley Council	
monwealth Club of Calif.	
fayette Improvement Assn.	
ntra Costa County Taxpayers Assn.	
fayette (French) Club	
te Vista Improvement Assn., Orinda	
ional Organization of the eagues of Women Voters	
land Cha., League of Women Voters	
F. Ch., League of Women Voters	
blo-Concord Ch., League of Women Vtrs.	
dmont Ch., League of Women Voters	
F. Bureau of Governmental Research	
t Bay Ch., National Safety Council	
F. Ch., National Safety Council	
Orinda Association	
ei Voters League	

GOVERNMENTAL ORGANIZATIONS

For	Against
n. of Bay Area Governments	Albany City Council
F. Planning Commission	Antioch City Council
F. Board of Supervisors	Brentwood City Council
nut Creek City Council	Pittsburg City Council
asant Hill City Council	Albany Board of Education
land Planning Commission	
cord City Council	

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LABOR ORGANIZATIONS

For	Against
Alameda County Bldg. Trades Council	San Francisco Labor Council
United Steel Workers of Am., Sub-Dist.#3	Central Labor Council of Contra Costa County
S. F. Bldg. & Const. Trades Council	
Contra Costa Bldg. & Const. Trades Council	
Northern Calif. Dist. Council, Intern. Longshoremen & Warehousemen's Union	

PRESS, TV & RADIO

For	Against
KCBS	Valley Pioneer, Danville
KPIX	Pittsburg Post Dispatch
KGO-TV	Brentwood News
KRON-TV	Berkeley Gazette
Walnut Creek, Orinda & Lafayette Sun Papers	Hayward Daily Review
Oakland Tribune	San Leandro Morning News
Contra Costa Times	Alameda Times Star
Livermore Herald & News	
Concord Transcript	
Livermore Pioneer	
Montclarion	
S. F. Shopping News	
S. F. Examiner	
Richmond Independent	
Claremont Press, Oakland	
San Francisco Chronicle	
San Francisco News Call Bulletin	
East Bay Labor Journal	
Fremont News Register	
Hokubei Mainichi	

POLITICAL ORGANIZATIONS

For	Against
Federated Young Democrats of S. F.	
New America Democratic Club	
Citizens Political Advisory Council	
Veterans Political Council of S. F.	
Americans for Democratic Action	

PROFESSIONAL GROUPS

For	Against
East Bay Ch., Am. Inst. of Architects	
Golden Gate Ch., Am. Inst. of Architects	
Northern Calif. Ch., Am. Inst. of Planners	
S. F. Planning & Urban Renewal Assn.	
Golden Gate Ch., Am. Society of Professional Engineers	

ORGANIZATION REPRESENTATIVES

For	Against
Mrs. Edna H. Twitchett, Pres., S.F. Ch. of American Assn. of Retired Persons	
Clarence Lord, Pres., Communications Workers of America, Local 9415 in Oakland	
A. H. Moffett, Jr., VP., Alameda Unified School District	
W. L. Crowe, head of Albany Chapter of American Assn. of Retired Persons	
Mrs. Alexander Van Frank, Pres., Coordinating Council of Eastbay Sr. Citizens	
Mrs. Richard Callaghan, Pres., Alameda Cty. Ch., National Committee of Catholic Women	

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For	PUBLIC OFFICIALS	Against
ov. Edmund G. Brown		
andidate Richard M. Nixon		
r. Robert C. Weaver, HHFA Admin.		
obert B. Bradford, State Dir. Pub. Works		
. M. Gilliss, Exec. Dir., LAMTA		
alter McCarter, GM, Chic. Transit Auth.		
aul Bissinger, Pres., S.F. Police Com.		
onald C. Hyde, G.M., Cleveland Trans.System		
aspar W. Weinberger, Republican State Chm.		

For	CONGRESSMEN AND CANDIDATES	Against
on. John F. Shelley		
on. William S. Mailliard		
on. Jeffery Cohelan		
ndidate Leonard L. Cantando		
on. John A. O'Connell		
on. Geo. P. Miller		
ndidate Harold Petersen		
ndidate W. Donlon Edwards		
ndidate Charles I. Weidner		

For	LEGISLATORS AND CANDIDATES	Against
on. Edward M. Gaffney		
ndidate Lawrence Becker		
on. Charles W. Meyers		
ndidate Chester Harris		
on. Phillip Burton		
ndidate Charles Frankel		
on. Milton Marks		
ndidate Josiah Beeman		
ndidate John Francis Foran		
on. Robert W. Crown		
on. Nicholas C. Petris		
ndidate Charles R. Hoge		
on. Don Mulford		
ndidate Robert L. Hughes		
on. J. Eugene McAteer		
on. John W. Holmdahl		
ndidate Timothy Abel		
ndidate John A. Anderson		

For	COUNTY SUPERVISORS	Against
on. Peter Tamaras		Hon. Edmund A. Linscheid
on. William C. Blake		Hon. Mel Nielson
on. Roger Boas		Hon. Francis Dunn
on. Joseph Casey		
on. Harold Dobbs		
on. Charles Ertola		
on. John Ferdon		
on. Clarissa McMahon		
on. Jack Morrison		
on. Joseph Tinney		
on. Emanuel P. Razeto		
on. James A. Kenny		
on. Thomas Coll		

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For	MAYORS	Against
Hon. George Christopher, San Francisco		Hon. Joel Parker, Jr., Albany
Hon. Franz S. Collischonn, Alameda		Hon. D. E. Wayne, El Cerrito
Hon. Carl W. Flegal, Fremont		
Hon. Winslow W. Hall, Piedmont		
Hon. Claude B. Hutchison, Berkeley		
Hon. Lenard Grote, Pleasant Hill		
Hon. Robert A. Nelson, Walnut Creek		

APPENDIX C

TESTIMONY OF ALFRED J. LUNDBERG

ANSWER LIES IN AN "UNORTHODOX SYSTEM" *

If we are to succeed in solving the problem, we must also face the fact that no existing system—no "orthodox" system, of rapid transit can solve it.

We must evolve a system that can effectively meet the changes which have come upon us in the last three decades. We must recognize, and meet, three great factors:

1. Business will continue to be done during the daylight hours, and transportation from home to business must be performed during brief peaks.

2. Large numbers of people will live in suburbs, where there is garden space and breathing space.

3. No form of public transit can serve every home in the suburbs at a cost that will induce people to use it in preference to the admitted convenience of the automobile.

Fortunately, the progress of science has made it possible to create a system that can meet each of these conditions.

Such a system, with capacity equal to at least four five-lane freeways, with no grade crossings, would be designed particularly to cater to the vast majority who now commute by automobile. As has already been stated, no "orthodox" system can do this. It must be a system which assumes that suburbanites will still use their automobiles, not to drive to the city, but to drive from their homes to self parking facilities at each station on the system. Such stations would not be in the suburban cities, as at present, but between them, where land for the parking structures would require less destruction of existing homes, etc. In the case of the Peninsula, for example, they could be east of Bayshore Highway in what is now tideland.

The system must be fast, it must be comfortable, and it must operate at very close headways during the peak hours—for the automobile has made people impatient of waiting even a few minutes.

It must distribute its patrons reasonably well over the industrial, financial, and shopping areas of the metropolitan center—for the automobile has made people impatient of walking.

It must charge a fare so low that it becomes absurd to commute to the metropolitan center by automobile. This item is a "sine qua non"—for no one counts the cost of using an automobile, while everyone counts the cost of a transit fare. Any fare greater than 10 cents from the usual commuter area will fail to accomplish the purpose. That is also a convenient fare to collect at modern turnstiles.

Such a system, with capacity equal to at least four five-lane-in-each-direction freeways, could be built for the cost of one such freeway, and would of course eliminate the cost of parking facilities otherwise necessary for the automobiles that the freeways would bring in.

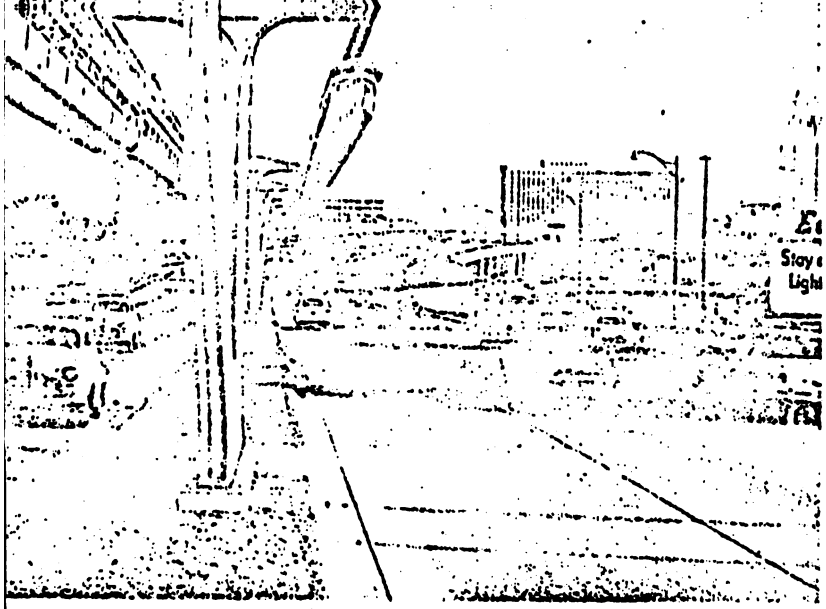
It would have no grade crossings; would be in subway in the metropolitan area for esthetic reasons, and at grade, in subway, or overhead, in the suburban areas as the topography or esthetic factors might dictate.

If it is really to solve the problems such a system must differ radically in three respects from existing commuter systems:

1. The form of trains used.
2. The method of operating the trains.
3. The method of financing the construction.

No new inventions nor devices untested by long use are necessary, but merely the adaptation of proven elements to this particular use. There is no hazard whatever that anything suggested herein "won't work"; all are proven by use in other fields.

* From remarks by Alfred J. Lundberg, past president American Transit Association, January, 1913.



Solving the rapid transit needs of people living and working in highly congested areas calls for long-range thinking and a departure from present-day conception of mass transit. This retouched photograph shows an artist's conception of an overhead monorail system as it would look following the course of a multilane freeway. Such a system is just one of several types suggested to meet mass transit needs.

The trains should be long, streamlined, ar-
ulated trains. (Articulation is the placing of
cks at joints between car body sections, as
main-line streamline trains.)

All the principles evolved in the develop-
nt of the most up-to-date street car
uld of course be incorporated; rubber-in-
wheels, rubber-sprung trucks, longitudi-
motor shafts, multistep control with accel-
ion and deceleration of three miles per hour
second or more, braking by combination of
tance, automobile-type band brakes, and
gnetic track brakes; light weight construc-
; rubber-foam seating, etc. Loading and
oading would of course be at car floor level.
The long articulated trains would permit
venient distribution of the load to take ad-
tage of all available seats; it is of course as-
ed that the service would be operated on
basis of a seat for every passenger.

Another purpose of using long trains
o get maximum capacity. Minimum
e headway is in the vicinity of 40
nds; trains seating 600, operating on
0-second headway, can carry 54,000
ed passengers per hour, but one can-
reach a 100 percent load factor in
ctical operation, unless it be for spe-
events as to or from a football game.

Herein lies the principal key to the neces-sary low fares, for in "orthodox" transit operations, direct labor is 55 percent of operating revenue. In commuter service, operating labor is the crucial item.

Key System's railway on the San Francisco-Oakland Bay Bridge has General Railway Signal Company's system of "cab signal train control," in which each of four permitted speeds, depending upon the occupancy of track ahead or upon curves, etc., is indicated to the motorman by visual signals in his cab. If the signal changes to a more restrictive indication, a bell rings to remind him. Unless he responds within a few seconds, the apparatus takes over. Signals are transmitted to the train by magnetic induction, being picked up from the running rails by a coil suspended over the track. The running rails are electrically divided into "blocks"—the length varying with the grades,

curves, etc. A train in any "block" short-circuits the current flowing in the running rails of that block; this causes appropriate signals to be given following trains for as many blocks behind as are necessary for absolute safety, bringing about stoppage or reduction of speed as may be needed.

It might even seem simpler and quicker to eliminate the motorman, and let the signals themselves, instead of being merely visually displayed to him, do the work. No risk is involved, for unless everything is working the train cannot move at all.

No operator is used on an automatic elevator, yet in modern models it not only stops at any one of any number of floors, but reverses its direction of travel on the pushing of a button, and returns to ground floor after being idle for a predetermined interval.

As in modern automatic elevators, the trains could not start until all doors were closed; no doors could open (except by hand in emergency) unless train is at complete stop at the exact position in the station. Unlike present subways, trains would stop at exact spots, by mechanism similar to "self-leveling" elevators; this would permit the use of automatic doors on the station platforms as well as on the trains, and eliminate the hazard of people being pushed off into the track area. All doors would have "sensitive edges," so that no one could be caught in a door; if it touched anyone, it would reverse its movement.

Some distance back of the doors on station platforms there would be modern turnstiles, which would lock a few seconds before departure of train, so that schedules could be maintained despite late-comers holding platform and train doors open by means of the sensitive edges—as often happens in the existing subways.

The whole would of course be under the control of train directors at a central point, who would have before them the same kind of illuminated map of the system that is used by main line railroads having "centralized train control." This shows the position and progress of each train. They would also be in communication with each train by carrier current telephones, and with each station by wire. They would also, by industrial television, observe the arrival and departure of trains at each station, and any unusual condition that might arise.

One employee on each train would give information, preserve order, and telephone train control for help at next station in event of illness or disorder on board, or in case of any other unusual condition. These might be part-time employees.

The train directors could, by remote control devices, cause any station to be by-passed if train fully loaded (of which they would be informed by employee on board), or in the event train was destined to storage at close of peak. Some 70 percent or more of the equipment works in the short peaks only; the nonpeak can be served by 30 percent of the equipment in present practice. It may of course be that fast 10-cent service would induce much more nonpeak riding than is customary at present.

No new invention is needed for completely automatic operation. All necessary devices now exist and are in actual use in other fields.

The free-running speed would probably be some 65 miles per hour; higher speeds are attainable but involve higher cost for both capital and power, and are of little value in suburban service because the higher the speed, the greater the time lost in deceleration for station stops and acceleration afterwards.