EVALUATION OF A MASS TRANSIT SYSTEM:
AN INVESTIGATION OF
POTENTIAL IMPACTS

A Thesis
Presented to
The Graduate Faculty
California State College, Hayward

In Partial Fulfillment
of the Requirements for the Degree
Master of Business Administration

By
Leone M. Nidiffer
May, 1972
EVALUATION OF A MASS TRANSIT SYSTEM:
AN INVESTIGATION OF
POTENTIAL IMPACTS

By
Leone M. Nidiffer
ACKNOWLEDGMENTS

During the past year I have received assistance from a great many people to whom I owe much gratitude. My primary appreciation must go to Dr. Allen J. Schuh, my advisor, who offered both encouragement and an infectious enthusiasm for the project. I am also most grateful to Dr. John H. Sims and Dr. Scott H. Partridge who consented to serve on my thesis committee and whose comments and suggestions are valued.

I wish to thank the Public Relations Staff of the Bay Area Rapid Transit District for their courtesy and to acknowledge the district library as a valuable source of information. I also received research assistance from the staff of the Alameda County Business and Government Library who devoted much time to helping me locate materials.

I am indebted to the students of Dr. Henry J. Rath's Spring, 1972 Management 6650 Seminar in Business Policy, section 01, for the ideas they generated during a discussion of this topic and I appreciate the opportunity which was provided me for the presentation of my thesis topic.

I appreciate the cooperation offered me by the staff of the Fremont, California, City Planning Department. To
my most valuable advisor on urban development, my husband, Mr. Frederick V. Nidiffer of the City of Palo Alto Department of Community Development, I must offer my deepest appreciation.

Finally, to my many friends and acquaintances who so willingly shared with me their commuting experiences and their expectations for the Bay Area Rapid Transit System, I must offer my thanks.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. ECONOMIC IMPACT</td>
<td>4</td>
</tr>
<tr>
<td>III. POLITICAL IMPACT</td>
<td>15</td>
</tr>
<tr>
<td>IV. SOCIAL IMPACT</td>
<td>23</td>
</tr>
<tr>
<td>V. ENVIRONMENTAL IMPACT</td>
<td>30</td>
</tr>
<tr>
<td>VI. CONCLUSION</td>
<td>33</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>35</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>39</td>
</tr>
</tbody>
</table>
I. INTRODUCTION

When the Bay Area Rapid Transit District was created by act of the California State Legislature in 1957, its stated purpose was to reduce traffic congestion. It was expected that the mass rapid transit system to be developed would exceed in benefit its projected cost. Benefits, as expressed in the 1956 engineering study, were to be realized in reduced hours of travel time, reduced cost for trucking goods due to a lessening of highway congestion, improved property values, and a delay in the need for additional freeways and bay crossings (Parsons, Brinkerhoff, Hall and Macdonald, Engineers, 1956).

In November, 1964, citing the benefits developed by the engineering study, the Bay Area Rapid Transit District obtained from the voters permission to issue seven hundred ninety-two million dollars worth of general bonds for a seventy-five mile system which is to include an underwater tube from Oakland to San Francisco. Eight and one-half years later, much delayed and much over budget, having had to seek additional funds through a special sales tax (Senate Bill No. 2, passed March, 1969), the transit system is still not in operation.

While other metropolitan areas watch, the Bay Area
Rapid Transit District (BART) struggles with monumental problems in design and coordination of what has become a 1.4 billion dollar project. It cannot be denied that progress has been made—great progress. Right of ways have been purchased, tracks laid, test cars run. Current forecasts call for the beginning of preliminary operation in September of 1972. Observers, many of whom feel that the need for a similar project in their own urban areas, look to the San Francisco area BART experience for answers to their own problems.

As public awareness has grown about the problems of pollution, urban sprawl, the inner-city ghetto, and preservation of the environment, a cost-benefit analysis based primarily on time and dollar savings for commuters and improved property values appears simplistic. The impact of the BART system, or any similarly extensive mass transit system, will be felt in a variety of areas: social, economic, and environmental. The evaluation of BART and future mass transit systems should include an investigation into a wide range of factors.

It is the purpose of this investigation to identify the potential impact of such a mass transit system on four areas of concern: economic, political, social, and environmental. An attempt will not be made to quantify these effects but rather to point out their extent and significance so that a subjective evaluation of them can
be included in the evaluation process, both in measuring the worth of BART and in arriving at cost-benefit figures for future similar projects.
II. ECONOMIC IMPACT

It might be expected that the greatest economic impact of the BART system would fall upon the commuters who will use the system. Yet it never was the primary objective of BART to save the commuter money. Instead, the emphasis has been, and is, upon safety, comfort, speed, frequency of scheduling, convenience of access for the passengers, better distribution at the points of origin and destination than is currently possible with existing transit methods, and ample parking and station facilities so that BART may provide an alternative to the private automobile at fares comparable to existing commutation rates. By the terms of the 1957 legislation which established the transit district, fares are expected to cover operating costs, with tax revenues to be devoted solely for capital expenditures (San Francisco Bay Area Rapid Transit Commission, 1957).

Yet, for those commuters who transfer from their automobiles to rapid transit, it is expected by BART planners that a considerable savings will result. Currently, costs for automobile operation, maintenance, insurance, and depreciation amount to over twelve cents a mile. In addition, automobile insurance rates are generally higher for automobiles used for commuting to and from work.
Actual out of pocket savings for those using the system will vary according to miles travelled, cost of feeder system, and cost of parking facilities, but it is doubtful that these costs will approach the twelve cents a mile figure of the private automobile. The availability of mass transit facilities, when combined with the feeder lines which are expected to develop, may well eliminate the need for a second or third family car primarily devoted to the work commute. The savings to the commuter which might result would be considerable.

Economic savings for area residents might well result from a reduction in traffic congestion as it affects those matters originally cited in the pre-BART engineering study (lower trucking costs, reduced need for new freeways and bay crossings). Additionally, a lessening of congestion might result in fewer accidents with a consequent lowering of insurance rates (for automobile insurance rates are based upon a composite of factors which include population density and accident rate in the area of residence).

In terms of tax revenues and property values, BART may be expected to have considerable impact. In Fremont, the southernmost extension of the BART system, property adjacent to the transit station, property which was agricultural land ten years ago, has sold for over sixty-five thousand dollars an acre. Where once the landscape was dotted with cabbage fields and an occasional farmhouse,
a large and expanding shopping area featuring several department stores has grown up. High rise apartment buildings have been erected, each proudly advertising its nearness to the BART station.

In San Francisco, the largest city in the BART system, considerable development has occurred in the financial district and futuristic buildings are changing the character of the area around the BART lines. In Oakland, and in other areas to be served as well, new buildings have been erected and entire new subdivisions have been advertised as "just minutes away from San Francisco by BART trains."

There is no denying the impact on property values for those areas close to BART facilities. Although some land was removed from the tax rolls to be used in the development and operation of BART, additional revenues from new apartment and office complexes and shopping centers built to take advantage of BART facilities should more than compensate for any losses. Indeed, outlying suburban areas such as Fremont project tremendous rises in property valuation directly attributable to the rapid transit system.

Just as some areas will benefit from increased valuation, others will find themselves outside the main stream, cut off from the mass transit system by distance and natural boundaries. Before including these areas in the taxation area for the funding of capital outlays, it is essential that their wants and needs be taken into account.
In times when growth is no longer considered the universal good, it may well be discovered that the unserved areas may be quite content to forego economic growth and remain outside the developing region. Increasingly, outlying suburbs are talking of, or voting for, a restriction in growth. The City of Livermore in California passed such a "no growth" ordinance in April of 1972. However, where resentment may mount against the paying of taxes without the realization of benefits, it is essential that the economic impact on the unserved areas be considered in calculating costs and benefits.

An economic savings to area taxpayers can be expected from a reduced need for the construction of new freeways and bay crossings, for freeways entail not only construction costs but also removal of property from the tax rolls and potential deterioration of residential property values along the right of way due to excessive noise levels and exhaust pollution. Additionally, a reduced dependence on the automobile for work trips would create a reduced need for parking facilities, an extremely costly item in premium downtown areas. A reduction in downtown traffic in the large cities served would lessen the need for such expensive services as special police officers assigned to direct traffic. In its Working Paper I of the city's Transportation Plan, the San Francisco Department of City
Planning made the following statement in December, 1966:

Each additional auto entering the downtown during the rush hour requires an additional investment in streets and parking spaces amounting to $25,000. The carrying charges on this investment amount of about $4 per round trip per auto.

Perhaps the least considered area for economic benefit is the potential labor cost savings from reduction of worker stress and improved employee morale which might result from workers switching from long distance freeway commutes by automobile to a mass transit system. In times past, industries received their workers from the areas immediately surrounding their plants. Employees walked to work, rode on horseback, or took advantage of public trams, trolleys, horsecars, or the like. The pace was slow and the distance travelled was small. With the development of modern, faster means of transportation, and most especially with the emergence of the personal automobile, the growth of cities has been greatly affected. The demand for increasing mobility has also had a great impact on the character of urban life and on the placement of the industries which help to shape and form our modern urban areas.

Industries are moving outward from the old central business districts, and with this move has come an increased dependence on the automobile for work trips. A glance at the vast parking lots surrounding plants in the new suburban industrial areas is instant proof of this reliance on the private car, and new zoning codes routinely require a
certain number of parking spaces based on the size of the building, assuming that the workers will rely on the private automobile for transportation. The paving and maintaining of such parking lots are direct expenses to the employer, expenses that the industries have come to accept as necessary. Industries of today depend on their employees' use of their personal cars, and this dependence can be expected to continue to grow wherever mass transit facilities are not available.\footnote{For U.S. Census figures on transportation methods used for work trips see the Appendix.} One study of long distance commuters (those workers who travelled over twenty miles a day to work) showed that ninety-eight per cent of the work trips were made by automobile (Lapin, 1964).

It is possible to find freeway drivers who claim that they are entirely unaffected by the strain of rush hour driving. They can be seen sipping their morning coffee and reading their newspapers as they move along the freeways. This may be true of some drivers at some times. But what of the average driver? How does he feel about his morning drive?

In a survey of over two thousand six hundred automobile commuters, the Editors of Fortune found that thirty-two to thirty-nine per cent did not enjoy driving in present day traffic and would switch to public transportation if it

\footnote{For U.S. Census figures on transportation methods used for work trips see the Appendix.}
came close to matching their automobile trips in time, cost, and convenience. An additional thirty-two to thirty-nine per cent would consider switching to a first class transit system, if such were available. These drivers averaged from nine to fourteen miles one way distance which they covered in approximately thirty minutes (Editors of Fortune, 1958). This represents a majority of workers who do not enjoy their commuting but must rely on the automobile because no alternate is available which offers comparable speed, cost, and convenience. It would appear reasonable to assume that those workers who do not enjoy their trips to and from work might carry their dissatisfaction over into working hours, and this might well result in a poor attitude toward the job and an increase in turnover or absenteeism.

The cost of "employee morale" has not proved to be easily quantifiable, yet an inclusion of human factors such as worker attitudes would intuitively appear to deserve a place on employer financial statements, just as human asset accounting is beginning to appear on balance sheets. In determining the compensation which a worker will accept for foregone leisure time, the worker considers travel time to be part of the sacrifice, therefore the length of the journey to work and the toll in energy that it takes are actually economic costs to the employer. Thus the work

\[2\] For complete survey results, see the Appendix.
commute is a part of the market processes which establish wages and consequently represents a cost to the company.\(^3\)

With measurements of heart rate, respiration rate, and galvanic skin response, scientists reported that Californians on busy freeways endure more stress than astronauts in orbit (Science Digest, 1963). Although the experienced freeway drivers studied appeared outwardly calm and did not seem aware of their own tension, the measurements (which are good indications of general emotional state) showed an increase with every lane change, every application of the brakes, every time that another driver cut in front of the subjects, or every time traffic became congested. One subject, whose pulse rate was running about 79, had an increase to 111 as soon as he entered the freeway. His respiration rate averaged 20.5 with increases to a peak of 27. Another driver, whose normal pulse rate was 78, registered over 100 several times, with a peak of 115. This man's respiration rate varied from 19 to 24, with an average of 21.7 over the ten mile drive.

In contrast, astronaut John Glenn had a pulse rate of 80 to 90 during orbit in space, with a jump to 114 at

\(^3\)For an in depth treatment of the market processes which establish wages, including provisions for commute costs, see Lowdon Wingo, Jr., Transportation and Urban Land (Washington, D.C.: Resources for the Future, Inc., 1961) p. 53-62.
blastoff and 143 during the most critical re-entry phase. Astronaut Scott Carpenter had a measured heart rate of 60-74 during a similar ride, with peaks of 96 at blastoff and 104 at re-entry. Respiration rates averaged 8 to 15 for Glenn and 10 to 18 for Carpenter.

The conclusion is that California drivers of busy freeways (and all subjects tested were experienced freeway drivers) register a great deal of stress, more than they may be aware of. Furthermore, those who studied these drivers felt that the type of stress which was evidenced was the type of stress which may wear a man down (Science Digest, 1963).

Clearly then, there is some cost borne by the commuter in terms of tension and stress. But does the cost concern only the driver himself? Studies on stress in industry have shown that a "recovery period" exists after the activity which produces stress, and that there is continuing physiological work above the resting rate during that period (Brouha, 1960). If this recovery period continues into the work hours, then an immediate and direct cost to the employer of long distance commuters could be shown. These costs might exist in the form of slower production following the freeway drive, increased spoilage during the initial period of work, or increased inter-worker tension which might affect turnover and absenteeism.
In writing of this problem, George M. Smerk (1965) states:

The physical and mental wear and tear on drivers from their twice-daily bout with traffic is undoubtedly of great magnitude. After a sharp tussle with morning traffic, the worker, whether blue or white collar, has much of the edge taken off his productive abilities. Cutting down the productivity of labor raises the cost of work performed; these costs will eventually be reflected in higher prices. The fatigue engendered by the journey home from work is a personal cost to the worker which dulls his ability to enjoy the fruits of leisure time. Added to this, the time-consuming nature of congested automobile travel seriously cuts into the individual's free time.

In the area of individual and organizational behavior, much has been written about the nature of drives. The one drive not usually emphasized—the drive to work—may well be one which results in great cost to the employer and thus makes up an important part of labor costs. Reduced productivity and the desire to seek compensation for tension and stress and lost leisure time encountered on the way to work may well have a significant impact on wage rates. A mass transit system which provides a good alternative for the worker, one in which he will be free to read, converse, nap, or play cards—true leisure activities—instead of concentrating on traffic conditions, may well be reflected in labor cost savings, an economic benefit to the companies involved and to the entire community.

It may be that the economic impact of a mass transit system in terms of reduced commuter expenditure, lower
trucking expenditures, reduced need for new freeways and bay crossings, reduction in automobile insurance rates, increased tax revenues from higher property values, reduced need for parking facilities and related traffic services, and potential labor cost savings will appear sufficient to justify the introduction of a mass transit system into urban areas which have no adequate transportation facilities and suffer from freeway congestion, but the passage of general bond authorization propositions has become increasingly difficult and voters have begun to consider social, political and environmental effects in their decision making process. The impact that a mass transit system is expected to have upon these areas is great and deserving of consideration.
III. POLITICAL IMPACT

The political effects of a project as massive as a mass rapid transit system are varied and far reaching. The establishment of a rapid transit district or other supervising body to encompass several counties creates a new layer of government, between the county and the state, a layer with taxing powers and a responsibility to a wide range of interests.

In the case of BART, the project was originally designed to cover the entire southern San Francisco Bay Area and to include five counties. Early in the planning stage, however, the two western counties withdrew from the system. These counties were already well served by two transit systems, Greyhound Bus Lines and Southern Pacific Railroad, and felt the least immediate need for a new means of rapid transit. This withdrawal was not accomplished without the generation of animosity, and charges were leveled that San Mateo County and Santa Clara County were merely seeking to avoid paying their share of the capital outlay.

When several counties combine to jointly plan a project of such magnitude, and one or more of them subsequently withdraws from the project, the seeds of disharmony are sown and later cooperation on other district ventures may be
seriously hampered. Charges leveled in disappointment may be continued until they are accepted as established fact. Future efforts in the areas of community planning, pollution control, or coordination of plans for the development of jointly shared natural resources may be colored by feelings that "they expect us to pay for something that is not our problem," or "they aren't willing to pay their fair share for benefits received."

In the case of BART, the three remaining counties, San Francisco, Alameda, and Contra Costa, have borne the total burden for the capital expenditures of the transit system through property and sales taxes. A feeling exists that no lines should be run into San Mateo or Santa Clara Counties unless those counties are willing to assume a full share of the capital expenditures of the entire project. This creates a dilemma, for many of the residents of the three counties work in the two nonmember counties and will not be able to take advantage of the transit system as an alternative to automobile commuting unless service is extended. The leaders, and through them the residents, of the nonmember counties originally withdrew from the district because they felt that the cost was too high for their needs. Since that time the costs have risen. It seems unlikely that San Mateo and Santa Clara Counties would vote to accept a portion of the present debt since they previously refused to share in the lesser amount.
To further complicate matters, the outlying areas of two member counties, Alameda and Contra Costa, are not scheduled to receive service under the present plan, yet they have been paying property and sales taxes for its support. It is believed that before BART is extended into the nonmember counties, service should be given to those areas which have paid but not received benefits. However, no funds currently are authorized for this purpose.

Logically, the original plan for a transit system completely surrounding the lower San Francisco Bay, and even an extension into the northern counties as well, should be completed to best serve Bay Area residents. But the cries of "something for nothing" which accompany attempts to include nonmember counties and the counter complaints that the cost would be greater than the services rendered appear to make such a move politically impossible.

At the state level the impact of the mass transit district has also been felt. When costs rose and new means for financing was sought, attempts were made to arrange transfers from several funds. Those counties which were to be served by BART sought a transfer of gasoline tax revenues to rapid transit use. Other counties, with no mass transit plans, fought that proposal. Eventually the present plan for a special one half per cent sales tax levied in the counties served was passed. The attempted conversion of gasoline tax revenues to mass transit use was placed on the
ballot in November of 1971 and was defeated. This proposal was strongly opposed by major gasoline companies and created much political discussion.

The establishment of regional government for a mass transit system may also mark the beginning or the turning point for the establishment of similar bodies for other region-wide problems. Such middle layers of government may create an atmosphere for intercounty cooperation and the solution of problems too large to be solved by individual counties working alone.

The impact on local political leaders of the establishment of a rapid transit system may be very great. A mass movement of population from the more crowded areas to the outlying districts due to the new availability of transportation may greatly affect the political makeup of a legislative district. Representatives who once could count on the support of a rural community may find themselves facing a constituency which has previously been accustomed to city services. As population shifts continue, perhaps accompanied by shifts in party membership ratios, gerrymandering will occur as politicians seek to hold their positions. Redistricting may be frequently necessary in the affected area in order to comply with the "one man, one vote" concept.

At the city and county level, revisions in the general plan will have to be made to accommodate the rapid transit
lines and the changes which they can be expected to bring. New zoning will be necessary as developers seek to capitalize on potential property value increases. A general rise in affected property values can be predicted, with the areas immediately adjacent to transit stations receiving the greatest premium. These increased property values can be expected to generate increased tax revenue and, in many cases, increased taxpayer hostility. Increased assessment values on residential properties represent potential financial increases which the owners can only realize with the sale of their properties. In the meantime the increased valuation may raise the tax level to a point where residents may become resistant to all proposals which will affect their taxes. This may have the effect of making it difficult or impossible to pass bond issues even for badly needed facilities and services.

When a mass transit system comes into operation it may well serve to link the affected cities and counties into one political unit, obscuring artificial boundaries and helping to create the impression, which may some day lead to the fact, of one large metropolis. The political impact of such a shift from boundary dominated thinking would be enormous.

Additionally, the introduction of a mass transit system may affect long standing plans for freeways and bay crossings. Those who originally fought hard for the acceptance of new
freeway systems may be forced to publicly change their stands. Right of way properties which may have been acquired with much public debate and which may have required condemnation procedures amid adverse publicity (especially where the disruption of racial or ethnic centers was involved) may be found, as the result of the new mass transit system, to be unnecessary. Disposal of such unneeded right of way may be made tumultuous by charges that the original purchase was made under false pretenses, charges of favoritism toward developers who may purchase the land, charges of intentional disruption of neighborhoods for the purpose of making a profit. This latter charge would be likely since inflation will most certainly have caused the resale price to be higher than the purchase price paid the original owner.

With the introduction of a mass rapid transit system, cities and counties may find themselves called upon to perform new services. Feeder systems to carry passengers from their home to the transit stations are considered a valuable component of a total transit system. Local governments will find it necessary to coordinate existing transportation systems with the new mass transit system, and arguments may result over alleged duplication of service or over the difficulties in providing feeder service without a disruption in other functions.

Cities which previously have provided no public transit
facilities may have a difficulty in establishing local transit districts or annexing to existing ones. Citizens may be reluctant to authorize the expenditure of new tax monies before the rapid transit system goes into operation, and rising taxes may make them reluctant to approve any new ventures which may increase the tax rate further. After indicating through a sample poll that they desired a local transit system and would be willing to pay for one, the residents of the Union City, Newark, and Fremont communities at the southern end of the BART system rejected such a system by a wide margin in April of 1972. Some opposition to the proposal was due to alleged inadequacy of service, but most of the opposition has been attributed to a general reluctance to authorize any increase in the tax rate. The desire to provide feeder service as a necessary complement to mass transit may be met with a near insurmountable obstacle of voter opposition. A search for a new method of financing not based on property taxes may be necessary, and such a search will not easily be successful.

Finally, the adoption of a mass rapid transit system may well have an effect on the lifestyle of the area residents which must be accounted for in the planning process of urban development. An increased usage of bicycles to carry commuters to and from the transit stations may require a reduction in the number of parking spaces required, and zoning codes may need adjustment. It would be necessary
for the planning staffs of the affected regions to be constantly aware of changes in lifestyle and sufficiently flexible to allow for adjustment to them.
IV. SOCIAL IMPACT

The impact of a mass rapid transit system on the lives of the area residents may be great. For some, the mass transit system may present the first opportunity for convenient travel outside their city. For others, the alternative to automobile transportation may mean a freedom from stress, a financial savings, or an expanded area from which to choose a residence.

As American affluence grew, the private automobile became the primary means of transportation, and a way of life based on the presumption of automobile ownership was developed. City dwellers moved outward, creating suburbs, and to the suburbs came the retailers and shopping centers. Henry Ford's dream of automobile ownership for all was nearly met, and a strong growth in the number of families with two, three, and more automobiles developed. In the cities, buildings were torn down to create parking lots as "traffic jam" and "commute hour traffic" entered the vocabulary.

Left behind by this acceptance and dependence on the automobile were those who, through age, income, or health, were not able to own cars. Dependent on public transportation, these people were often forced to live in the
central urban centers where transportation, though often of diminishing quality, was available. In some areas, where no public transportation existed, these residents were limited to the distance they could cover on foot.

The introduction of mass rapid transit, hopefully accompanied by adequate feeder systems, can represent an enormous expansion in horizons for these people. For the first time, many of them will be able to make a free choice of locations to live or work in. Shopping need no longer be restricted to the immediate neighborhood. The means to travel where job openings exist will be available.

With the growth of the suburbs, industries moved out of the central cities, taking with them many of the blue collar jobs upon which ghetto dwellers depend. Without adequate transportation, these residents were unable to reach areas of employment opportunity and feelings of alienation grew. This lack of facilities for "inside out" commutes from the cities to suburban places of work was discouraging to the urban dweller. The McCone investigations of the Watts riots and the Report of the National Advisory Commission on Civil Disorders (1968) cited the lack of public transportation as a contributing factor to ghetto unrest. The opening of mass rapid transit facilities can free the inner city dweller from his transportation restrictions and make employment opportunities accessible to him.
Additionally, those who formerly were limited by lack of transportation may find great benefit in the new accessibility to schools and universities, sports and cultural events, and recreational facilities. No longer need those who cannot afford a private car, or those whose age or health precludes driving, be cut off from the many services and activities which a metropolitan area can offer. The freedom to travel which may be expected to accompany a rapid transit system may lend new feelings of independence and ease to those who previously felt trapped within their immediate areas.

For the automobile driver, the mass transit system may offer an alternative to congested freeway driving, an alternative so attractive that actual congestion may be reduced, a benefit for those who must, or who choose to, rely on their private cars. In addition to offering a means for safe, fast, convenient work travel, the rapid transit facilities will offer access to areas of recreation and culture as well as access to urban shopping districts. For the first time, the suburban dweller may be encouraged to leave his car, and with it the frustrations and stress of congested driving, behind when he makes his work and recreational journeys outside his area of residence. Long distance commuters may return home from their day's labor less tired, less strained, more able to enjoy their leisure time. Wives who stay at home may feel less dependent on
ownership of a second car, more free to travel, to attend educational or cultural events, or to spend the day shopping in the large cities without the need to avoid the rush hour traffic, without the fear of freeway driving which many may possess.

With the increased travel speed of the rapid transit system, working couples will have increased freedom to pick their location of employment, as husband and wife may work many miles from each other in opposite directions and yet be able to find a residence within reasonable commute time for both. This may prove to be an increasingly important factor if, as is predicted, the number of wives who work outside the home continues to grow.

As the number of urban city dwellers who choose to work in the suburbs increases, due to increased availability of transit facilities, the amount of contact between ethnic and racial groups, at least during work hours, may be expected to grow. This, when combined with open housing laws which allow greater choice of residence areas, may help to lessen intergroup tensions. While it cannot be shown that merely placing members of hostile groups together will serve to lessen conflict, it is generally believed that working together to accomplish a mutually accepted task (as would occur in the job situation) does help to reduce conflict, and when this effect is combined with a lessening of the frustration of confinement to a ghetto area due to housing
restrictions or lack of transportation, it can be hoped that a positive effect on intergroup hostilities will result.

In terms of lifestyle, the ready availability of a first class transit system, combined with a local feeder system, may result in a decreased use of the automobile for other than work trips. With current interests in health and fitness, it may be that an increase in the use of bicycles for local transportation will be seen. In many areas the use of bicycles has already been growing, so much so that special facilities for their safety and storage have had to be added to public roads and buildings. An increase in the use of bicycles, with a resultant increase in exercise may have a favorable effect on health.

The abandonment of the concept that every suburban home must feature two automobiles may well be seen, as transportation for children becomes more the duty of public transit systems and less the duty of suburban mothers in station wagons. Ownership of a commute automobile which spends nine hours a day parked in a company lot or downtown garage may one day be considered unnecessary and wasteful.

Just as the urban dweller will gain increased access to the suburbs, the suburban dweller will have increased opportunity to rediscover the excitement and the variety of a downtown urban center. Shoppers may return to the large cities for once a week specialty shopping if they are freed
from the strain of long freeway drives. Workers who have deliberately avoided seeking employment in large urban areas because of the commute problem may be attracted to the cities by the speed and convenience of rapid transit. Downtown areas can be expected to modernize, to make an effort to attract the workers (and thus the businesses) and the shoppers. Much of this activity can be seen along the San Francisco route of BART in anticipation of increased activity. This development of the inner city may well serve to attract back to the large cities those who, seeing only dirt and decay and crowding, fled to the suburbs ten and twenty years ago. New and modern high rise buildings, incorporating open squares, can be expected to appear, offering both office and residential units.

As traffic congestion is lessened and large areas are modernized and cleaned up, the city may well appear an attractive place for living, especially for those who have no children or whose children are no longer small, for there can be no denying that a large city can be an exciting and stimulating place to live. Those who are attracted to the cities by the speed and convenience of rapid transit may someday return to live in the modernized cities where they may find the additional convenience of living and working in the same high rise complex.

Increased freedom to travel independently for the elderly, the lower income levels, the young, or those unable
to drive may be one social benefit of rapid transit. Increased freedom to choose a place to live and work may be another. A reduction in the tension and strain of freeway driving and a resultant ability to enjoy free time may accompany rapid transit. A greater homogeneity of resident type between the cities and the suburbs as lower income groups move outward and middle class groups return to the cities may arise. Increased access to cultural, educational, and recreational facilities may be a byproduct of rapid transit. As distances are narrowed in terms of time, a change in the concept of the separation of city from suburb and one suburb from another suburb may be realized. The entire transit service area may meld, in the eyes of the resident users, into one large unit. A tendency to think and act in terms of the entire region may develop.

The impact of a rapid transit system on the lifestyle of the regional residents is potentially quite great, and it would be indeed an error to leave social effects out of the evaluation process.
V. ENVIRONMENTAL IMPACT

An increasing awareness of the environment and the necessity of reducing pollution and conserving natural resources makes the environmental impact of a rapid transit system a vital factor to be considered in the evaluation process. The inclusion of environmental effects in the analysis of all large scale projects has become essential in dealing with an ecologically aware electorate.

The prime impact on the environment expected to be realized from a rapid transit system is a reduction in air pollution. Automobiles are considered to be the prime cause of air pollution, accounting for up to eighty per cent of the contamination. Two tracks of a modern transit system may carry as much traffic as fifteen freeway lanes, according to BART designers.

A mass transit system, however, is not entirely free of pollution. It is projected that the BART system will eventually require three hundred seventy million kilowatt-hours of electricity per year, and the generation of such power will produce its own pollution, dependent on the method of generation used.

A freeway, in addition to noxious air pollution, generates noise pollution which may also be a hazard to
health and well-being. The noise generated by a rapid transit train may be controlled and engineered to remain well below a hazardous or even objectionable level.

Visual pollution, the introduction of unaesthetic elements into the environment, can also be controlled with rapid transit. Tracks may be sunken below ground level or even run underground, as the area and the community may dictate, and those areas which run at ground level or above may be designed to be pleasing or inoffensive to the eye. Attractive landscaping may be added, and the space below the elevated sections may be devoted to play areas or other green belt usage. The visual impact of a mass rapid transit system, although not a natural part of the environment, need not be objectionally obtrusive.

A rapid transit system may eliminate the need for many freeway lanes and bay crossings, some of which were previously planned and are currently being opposed on the grounds of ecological damage. By providing transportation for a far larger number of people than a similar right of way could, if devoted to freeways, it can be said that the BART system may have preserved many square miles of land which would otherwise have been turned to the asphalt of freeways. Freeways which would have run along the edge of the San Francisco Bay, requiring ton upon ton of fill, and freeways which were designed to run through scenic ridge lands may eventually prove unnecessary. An additional bay
crossing which is currently being opposed due to alleged disruption of the bay currents may also be proved unnecessary. The BART system runs through a tube under the bay with an absolute minimum of disruption to the ecological makeup of the bay.

The first instruction in the case of a Smog Alert is "Do no unnecessary driving." If a rapid transit system is developed and used, it may well be that the use of the automobile may be so curtailed that the likelihood of a Smog Alert will be significantly reduced. A mass switch to public transit would effect a tremendous reduction in air pollution. With the ready availability of mass transit and an adequate feeder system, driving to work by private automobile may one day be considered by most commuters to be "unnecessary driving."

A mass rapid transit system may be expected to reduce air pollution, create less noise pollution than a freeway, minimize visual pollution, and provide a reduced level of disruption to the ecological system by eliminating the need for alternate freeways. When run underground, although the economic cost increases, it creates no visual or noise pollution whatsoever.

In a nation which has begun to adjust its value system, it may well be that the environmental effects are the ones which will carry the most weight in the evaluation of a mass rapid transit system.
VI. CONCLUSION

No matter how well designed a mass transit system, its implementation is dependent on the ability to gain financing; in the case of a public system this entails voter approval. At a time when taxpayers appear reluctant to authorize any ventures which will increase their property taxes, it is extremely important that a project be thoroughly analysed so that all potential benefits may be identified and publicized. The mere recitation of direct savings for commuters may be met by a firm, "I wouldn't use it."

Where the sole purpose of a mass transit system is the reduction of traffic congestion on freeways, it might be that equal benefit could be obtained from any one of several alternate solutions including work staggering; the encouragement of car pools or bus usage through special freeway lanes, reduced tolls, or priority parking spaces; more extensive use of private commute buses which, like large car pools, pick up and deliver riders to their doors; or increased gasoline taxes or user charges. Many of these may accomplish peak hour traffic reduction at a considerably lower capital expenditure than required by a mass rapid transit system.

In most instances, however, greater benefits than
reduction of freeway congestion should be considered. A mass transit system can have considerable effect on the region it serves and, in evaluating its merit and determining a cost benefit relationship, the inclusion of a large number of potential impact areas is necessary.

This investigation has attempted to point out potential impact of a mass rapid transit system on the makeup of the district, politically and geographically, and on its residents, socially and economically. It may be possible to expand an investigation of impacts even further. Toward this end of the Department of Transportation awarded a one hundred eighty-six thousand dollar contract to the Metropolitan Transportation Commission of Berkeley, California, on March 7, 1972, as the first of a series of such contracts to measure the effects of the Bay Area Rapid Transit System. The BART system is the largest single urban transportation investment in the United States and an intensive investigation may discover far more areas of impact than have been enumerated here. It is certain that it will discover no fewer. The impact of a rapid transit system may eventually touch all areas of urban and suburban life. To limit an evaluation to only economic benefits would be a grave mistake.
APPENDIX

The two questions related to transportation which were contained in the questionnaire received by one of every four in the 1960 U.S. Census were:

If this person worked last week, answer questions P28 and P29.

P28. What city and county did he work in last week?
   If he worked in more than one city or county, give place where he worked most last week.
   a. City or town.................................
   b. If city or town--Did he work inside the city limits?  Yes.....  No .....  
   c. County.................. State................

P29. How did he get to work last week?
   (Check one for principal means used last week)
   Railroad....... Taxicab....... Walk only...
   Subway or elevated ..... Private auto Worked at home......
   Bus or streetcar.... Other means--Write in:
   ..........................................

MEANS OF TRANSPORTATION FOR WORK-TRIPS BY RESIDENTS OF METROPOLITAN AREAS OF 100,000 OR MORE POPULATION IN 1960

<table>
<thead>
<tr>
<th></th>
<th>Central Cities</th>
<th>Suburban Rings</th>
<th>Outside Rings</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Reporting (000)</strong></td>
<td>18,142</td>
<td>2,006</td>
<td>525</td>
<td>20,673</td>
</tr>
<tr>
<td><strong>Percent Distribution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Automobile</td>
<td>54.4</td>
<td>84.9</td>
<td>74.5</td>
<td>57.9</td>
</tr>
<tr>
<td>Rail, Subway, Elevated</td>
<td>10.1</td>
<td>1.7</td>
<td>9.5</td>
<td>9.3</td>
</tr>
<tr>
<td>Bus or Streetcar</td>
<td>19.6</td>
<td>10.5</td>
<td>7.3</td>
<td>18.4</td>
</tr>
<tr>
<td>Walked Only</td>
<td>11.0</td>
<td>1.5</td>
<td>2.9</td>
<td>9.9</td>
</tr>
<tr>
<td>Other Means</td>
<td>1.6</td>
<td>1.4</td>
<td>5.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Worked At Home</td>
<td>3.3</td>
<td>-</td>
<td>-</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Suburban-Ring Residents:

<table>
<thead>
<tr>
<th></th>
<th>Central Cities</th>
<th>Suburban Rings</th>
<th>Outside Rings</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Reporting (000)</strong></td>
<td>6,330</td>
<td>11,225</td>
<td>1,058</td>
<td>18,613</td>
</tr>
<tr>
<td><strong>Percent Distribution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Automobile</td>
<td>82.3</td>
<td>74.0</td>
<td>79.0</td>
<td>77.1</td>
</tr>
<tr>
<td>Rail, Subway, Elevated</td>
<td>6.1</td>
<td>0.3</td>
<td>6.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Bus or Streetcar</td>
<td>8.9</td>
<td>4.3</td>
<td>7.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Walked Only</td>
<td>1.3</td>
<td>11.7</td>
<td>1.7</td>
<td>7.6</td>
</tr>
<tr>
<td>Other Means</td>
<td>1.3</td>
<td>2.5</td>
<td>4.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Worked At Home</td>
<td>-</td>
<td>7.2</td>
<td>-</td>
<td>4.3</td>
</tr>
</tbody>
</table>

### FORTUNE MAGAZINE SURVEY RESULTS
**(in percent)**

<table>
<thead>
<tr>
<th>Number of Automobile Commuters</th>
<th>Los Angeles</th>
<th>San Francisco</th>
<th>Washington D.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>How they feel about their work trip:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not enjoy driving in today's traffic; would almost certainly switch to public transportation if it came reasonably close to competing with automobile trip in time, cost, and convenience</td>
<td>34</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>Driving to work convenient, but would seriously consider switching to a first class transit system</td>
<td>32</td>
<td>39</td>
<td>37</td>
</tr>
<tr>
<td>Enjoy driving; can't imagine switching to public transit</td>
<td>34</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>Could now use public transportation to commute to work but do not</td>
<td>42</td>
<td>90</td>
<td>85</td>
</tr>
<tr>
<td>Would use transit system of choice:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If round trip travel time matched present travel time</td>
<td>64</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>Only if it offered a substantial round trip time saving (ranging from 10 to 60 minutes)</td>
<td>19</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Doubt would use under any circumstances</td>
<td>17</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Facts about present automobile trip:</td>
<td>Los Angeles</td>
<td>San Francisco</td>
<td>Washington D.C.</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------</td>
<td>---------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Belong to car pool (percent)</td>
<td>12</td>
<td>46</td>
<td>54</td>
</tr>
<tr>
<td>Average 1-way distance (miles)</td>
<td>11.4</td>
<td>14.1</td>
<td>9.1</td>
</tr>
<tr>
<td>Average travel time home-to-work (minutes)</td>
<td>27</td>
<td>29.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Average travel time work-to-home (minutes)</td>
<td>32.5</td>
<td>33.5</td>
<td>33.5</td>
</tr>
<tr>
<td>Average speed for homebound trip in mph (from above figures)</td>
<td>21</td>
<td>25</td>
<td>16</td>
</tr>
</tbody>
</table>


Wilson, James Q. *The Metropolitan Enigma: Inquiries Into the Nature and Dimensions of America's "Urban Crisis."