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Urban Transportation Research and Development

A report prepared by the
COMMITTEE ON TRANSPORTATION
of the
NATIONAL ACADEMY OF ENGINEERING
for the
DEPARTMENT OF TRANSPORTATION

NATIONAL ACADEMY OF ENGINEERING
Washington, D.C. 1972

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April 5, 1972

Honorable James M. Beggs
Under Secretary
U.S. Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20590

Dear Mr. Beggs:

In August 1970 the Department of Transportation made arrangements with the National Academy of Engineering to provide broad engineering services in the transportation field to the Department. The Committee on Transportation was appointed under the chairmanship of Dr. Seymour W. Herwald to respond to this need. The first task was identified as a study of urban transportation.

I am pleased to transmit herewith for your consideration the report on this subject prepared by the Committee. The report contains the observations of the Committee intended to aid in focusing new ideas and efforts on the problems involved with achieving improvements in urban transportation and urban development.

Sincerely yours,

CLARENCE H. LINDER
President

April 3, 1972

Mr. Clarence H. Linder
President
National Academy of Engineering
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Dear Mr. Linder:

I take pleasure in transmitting to you the report, "Urban Transportation Research and Development," prepared by the Committee on Transportation. The Committee, created by the National Academy of Engineering

in response to a request from the Department of Transportation to provide broad engineering services in the transportation field, has recently completed its first task, a study of urban transportation and related urban development. This report represents the views of the members and has been reviewed by the appropriate Academy committees.

We do not view this as a research report but as a presentation of the general consensus of the Committee, reached through the combined judgment of the members. This consensus is based on exploration of the issues with officials from the Department of Transportation, the Department of Housing and Urban Development, and other governmental agencies and with experts in the urban transportation–urban development field, including those from regional, state, and municipal agencies. These and other discussions were pursued at several Committee meetings, among them a two-week work session at Woods Hole and included the consideration of many documents and reports on this important subject.

In assessing the problems and the work to be done, it was necessary to contrast the current and past efforts with the magnitude of the need for future work. During this process, it became evident that considerable progress has been made by the relatively new Department of Transportation, and, therefore, we wish to emphasize that our observations should by no means be considered a reflection upon their efforts. Rather, it is our hope that the ideas expressed here will assist in the process, already begun, of realizing more effective transportation and a better quality of urban life.

Derived from our study is the Committee's belief that the research, development and demonstration programs of the Department of Transportation need to be strengthened and that the initiation of new efforts to solve the critical problems should be addressed at once. Appropriate suggestions for needed action are included in the report.

In conclusion, the members hope that this National Academy of Engineering Committee on Transportation report will aid in focusing new ideas and efforts on the problems inherent in the urban transportation–urban development field.

Sincerely yours,

S. W. HERWALD
Chairman

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1 The Urban Transportation Problem and a Revised R&D Program

The Office of the Secretary of Transportation, in July of 1970, requested the National Academy of Engineering, through a contract and formal agreement, to

1. Provide expert and broad counsel and advice on engineering matters through the National Academy of Engineering Committee on Transportation, whose membership should be so constituted as to include a number of the most knowledgeable people in transportation from a complete variety of backgrounds and disciplines
2. Review the previous efforts relative to the broad subject of research and development needs in transportation areas
3. Advise the Department of Transportation (DOT) with regard to the ways in which the content and scope of federal transportation research and development programs might be strengthened

In undertaking studies in transportation, the Committee closely coordinates its activities with the other National Academy of Sciences and National Academy of Engineering organizations that are conducting specialized transportation-oriented efforts.

In the initial stages of the work, the Committee held discussions with representatives of the Office of the Secretary and of the several administrations of the Department to identify the specific problem area considered to be of critical importance in which the Committee believed it could make a major contribution. During these discussions, the Committee noted that

in the areas of air, rail, and highway transportation there had been recent studies. Major legislation already in effect or enacted while the Committee's study was in process provided for programs concerned with the issues and problems identified with these modes. The Committee concluded as a result of this preliminary review that urban transportation, including the interaction between transportation and urban development, remained as one of the most urgent problems facing our society and should be given the highest level of priority in the Department. Furthermore, as will be described in this report, it is an area in which the Department of Transportation can provide leadership in the nation's efforts to resolve the paradox of the continued existence within a generally affluent society of inadequate housing, deteriorating public services, deteriorating physical environment, and, in general, the poverty of life among certain urban groups.

There are growing indications that the urban transportation problem will worsen. The number of people in the United States by the year 2000 is expected to increase by 65 million, and the number of motor vehicles could grow by 50 million. If present trends continue, most of this population growth will be in outlying portions of metropolitan areas. Despite significant accomplishments in the supply of urban transportation to date, the Committee believes that much greater effort will have to be expended to reverse current trends in the United States toward mounting transportation costs, declining standards of public transportation service, and the increasingly damaging side-effects of the automobile. This concern about the need for increased effort is strengthened by the conviction that many of the underlying causes of the difficulty go beyond the internal problems of the transport system itself and require a frontal attack on slums and blight and on the processes of urban growth. In some instances where there is sufficient transportation, there is frequently a lack of balance between the supply of transportation and the demands on the system. There is insufficient knowledge of the demand side of transportation and of how to provide the proper balance.

COST

The cost of urban transportation in the United States is high now, and it is rising. Of the over $190 billion per year estimated by the Department of Transportation as the total cost of transportation in the United States, at least $100 billion per year goes for urban transportation. This figure includes $80 billion in direct costs. The social costs such as the impact of transportation systems on urban esthetics and on the quality of urban life are difficult to measure, but as noted, are in part included in this estimate. (See Appendix B, pages 29–33.)

Growing pressures for safety equipment and antipollution devices for automobiles and the inclusion of more amenities and improved service for public transportation systems will increase the direct cost to the consumer by an estimated $4.0 to $5.0 billion per year by 1975, although there may be some reduction in indirect costs.

An additional rise in costs can be expected to result from the increasing world demand for materials and energy resources. For example, use of electrical energy and of energy for transportation is forecast to double by the year 2000, and transportation alone by that time is expected to use about one fourth of the total energy consumed.[8] These trends in costs, combined with a more dispersed urban population and consequent increased travel requirements, could mean that the ability to move in urban areas will have to be improved considerably to accommodate the growing population. One potential cost saving can be illustrated by experience in urban areas. An average one-way trip for commuters in New York City is 14 miles and takes 73 minutes; an average commuter trip in the United States is about 4 miles one way and takes about 15 to 20 minutes. Just doubling the average speed could save commuters many man-hours per week. Throughout the country, such savings in commuting time would represent a potential for additional production efforts of billions of dollars a year.[3, 32]

Action is necessary to control the costs of transportation, not only because these costs play such a direct key role in the quality of urban life, but also because of their broader relationship to the health of the national economy itself. Increasing costs of transportation are part of the problem of increased costs of production and the resulting deterioration of the competitive position of the United States in world markets. These effects add up to a growing disadvantage to low-income families, who are forced to spend a greater percentage of their income on transport (often public transportation unsuited to their needs) and who are also early victims of any faltering in the national economy.

DECLINING SERVICE

It is already a fact for millions of people without cars that many of the economic, social, and cultural advantages of the urban region are out of reach because new urban areas are being developed on the assumption that people will drive. Public transit in this setting is inefficient, and it cannot supply the services needed at acceptable costs. This large unfulfilled need for transportation contributes to the deep-seated problems of large segments of the urban population (Appendix B, p. 22).

There are millions of people in the United States living in poverty, and of those families with incomes below $3,000 in 1970, some 58 percent were without cars. Nearly 45 percent of heads of households age 65 or over have

no car. Most of the people in such households in the metropolitan areas depend on public transit. For these families and for many others who have no automobile, the time, cost, and inconvenience of using public transit are serious obstacles (Appendix B, p. 23).

DAMAGING SIDE-EFFECTS

Trends in urban transportation are having equally detrimental effects on the urban areas themselves. Among the most critical of these effects are air pollution and accidents: In spite of limited improvement in some areas, the pollution level in many localities is still unacceptable much of the time, and automobile-connected insurance claim payments have doubled in the last 10 years. In both these cases, the undesirable impacts occur primarily in urban areas. Noise has increased, and in many areas of cities now exceeds the continuous-exposure damage-to-hearing level of 90 decibels. Costs to decrease the effects of land pollution are forecast to rise by 50 percent in the period 1970–1975, and unplanned development along the streets in many cases may not proportionately increase the tax base.[28, 28]

This physical deterioration of the urban environment is in turn having a feedback effect on transportation. Automobile travel has increased by 51 percent to 900 billion miles annually in the last 10 years. Even though the rate of decrease in ridership on urban transit has been leveling off in recent years, still there has been a decrease in revenue passenger-miles over the last decade of some 17 percent.[3, 4] Since most inner cities are unpleasant to live in, people with cars move out and commute. Those who are poor or are without cars are forced to live in the run-down center cities, without access to jobs available in the newly developing fringes of the metropolitan area. Housing developments in the suburbs are often built without concern for the location of the jobs and services that support the urban population, with the result that an unnecessary volume of transportation must compensate for the absence of nearby employment. Unless these imbalances are corrected, urban life becomes a situation in which inadequate urban design results in an unnecessarily large amount of energy being used for urban travel.

The problems are not new. The United States aired its urban problems and stated its goals many years ago in a report of the National Resources Committee of the Executive Office of the President, *Our Cities,* in 1938.

Over twenty years later, the President's Commission on National Goals proposed a set of objectives for the sixties. These considered the changes that increasing affluence might have on the quality of life. The report, *Goals for Americans,* was published in 1960. In both of these reports, action was called for to eradicate the slums, to eliminate the processes of decay in the larger cities, to avoid the compulsory concentration of low-income and

minority groups in the old central cities, and to overcome haphazard suburban growth.

More recently, the President of the United States, in his 1970 State of the Union Message, repeated the call for a national growth policy to enhance the quality of urban life. Public policy, he reiterated, should seek to encourage planned growth and sensible alternatives to the congestion and pollution of giant urban concentrations.

What is new today is the urgency of the situation. Urban areas have reached the point where worsening physical and financial conditions and the outlook for further growth and transportation needs require a commitment to find better ways to deal with the problem. Public awareness has been sharpened by a national concern for the environment, by an increasing number of programs aimed at providing greater security for individuals, by a new wave of discontent among young people and minority groups, and by increasing evidence that the funds and the science and technology necessary for change are available.

JURISDICTIONAL CONSIDERATIONS

Improvements in institutional and social arrangements are needed at all levels of government. Over a decade ago, the National Academy of Sciences, reporting on its Conference on Transportation Research, noted that while there were technical and funding problems, a major difficulty in improving transportation lay in the institutional structure—that is, the political, jurisdictional, and other community organization systems that characteristically function in our urban areas.[18] That same theme (of either the failure, the inadequacy, or the obsolescence of institutional patterns around the country) has been repeated in a number of reports since that time. *Urban Design Manhattan,* a 1969 report by Regional Plan Association, Inc.,[26] describes the conflicts among many diverse institutions and the lack of common purpose; *The New City,* the 1969 report of the National Committee on Urban Growth Policy,[18] describes the problems that arise when institutions do not function efficiently; and the 1969 report of the Advisory Commission on Intergovernmental Relations, *Urban and Rural America: Policies for Future Growth,*[1] describes the difficulty in planning caused by the existence of many diverse jurisdictions. Based on its discussions with many individuals in the field of urban and transportation planning, the Committee has been persuaded that the problem is still critical and that intensive effort is needed to overcome it.

The Committee is also aware of the fact that these diverse jurisdictions have generated political pressures on the Congress, thereby increasing the incentive for support of projects that have short-term political benefits but that may not contribute significantly to the established urban transportation

goals within the philosophy advocated in this report. Further discussion of these and other issues may be found in working papers and consultant reports considered by the Committee during its study (Appendix B, p. 24 and 39).

AN EXPANDED AND BROADENED RESEARCH EFFORT

The complex problems described above require an expanded research program to aid in arriving at the most effective solutions. Research and development on transportation technology needs to be significantly supplemented by work in all of the relevant disciplines, not just engineering and economics. These programs would be aimed at gaining an understanding of needs, of social and environmental impacts and long-term effects, and of the effectiveness of alternative solutions. Research dealing with these factors is needed, as is research on trends in aspirations and revealed preferences.

A creative effort to achieve new urban systems requires information on which to base their design. Not enough is known of the social, political, and economic consequences, either short- or long-term, of changes in transportation modes, systems, and services. This lack of sufficient information convinced the Committee of the need for increased research that will lead to better decisions in the future. Transportation, instead of being used to accommodate congestion, should be used to serve growth and renewal. Technology makes possible a wide range of choices, but the choices need to be made in relation to urban goals. In making the decisions, full advantage should be taken of the efforts around the world in the last few decades, and particularly in the last few years, toward city and community design and development or redevelopment. There has been extensive experience abroad in rebuilding existing communities or building new ones—for example, in the Philippines, Malaysia, Sweden, and Great Britain. In this country, planning and construction or reconstruction of urban areas through efforts such as those of the New York Urban Development Corporation in Amherst and Staten Island offer insights into what approaches may succeed and what may fail. The DOT might well explore ways of encouraging the creation in other states of this kind of instrumentality, and through it devise ways of combining forces with the Department of Housing and Urban Development to influence the demand for urban transportation.

Expenditures for research and development by DOT are low in relation to R&D of other agencies.[21] According to information presented to the Committee by the Department of Transportation, the total Fiscal Year 1971 DOT budget (not including the St. Lawrence Seaway or National Transportation Safety Bureau) was $10,144,034,000.[30,31] Total research and development amounted to $181,562,000, of which $155,211,000 was

technological R&D and $26,351,000 was other research. In reviewing the individual items, the Committee estimates that some $22,893,000 was included in the program for multidisciplinary urban transportation R&D. Comparable figures for 1972 show that of about $239 million for R&D (final FY 1972 appropriations and supplementals are not completed), some $36,000,000 might be considered multidisciplinary. The Department's own requests were for much more than that—around $280 million for all R&D and $57 million for multidisciplinary R&D. These R&D estimates did not include funds for SST airframe and Highway Planning and Research (HPR). Other authoritative estimates have placed the annual requirement for transportation research and development at around $1 billion, with the urban transportation share recommended at about $200 million.[5, 29] The Committee notes that a new assessment should be made by the Department to arrive at a new budget planning figure that will include funds for the suggested increases in scope and scale outlined in this report. The suggestion by the Committee for an increase is consistent with the comparison between existing R&D funding and that recommended by a number of groups outside government.

The current reduced level of activity in the aerospace and defense fields has created a situation where there are many scientists and engineers currently available for work in transportation-related fields.[5] The Committee notes that forecasts by the National Science Foundation indicate that there may well be a surplus of 41,700 Ph.D. scientists by 1980, with 16,000 of these in engineering. While redeployment of manpower is not simple, it seems clear that enough professional people are available for needed transportation R&D.

POSSIBILITIES FOR CHANGE

There is another kind of urban future possible in which all income groups will enjoy more nearly equal opportunities and adequate housing and amenities of all kinds. The attainment of this kind of environment will to an important degree depend on how improvements in transportation are approached. Transportation policies can help create new and satisfying urban settlements, at lower total cost and with less energy consumed, provided that public policy and the necessary changes in institutions are aimed at that objective. Transportation is used by people to carry out functional desires or needs. As new needs are generated through change in work or residence, or desires change through altered recreational patterns, the transportation demand shifts. As the demand has shifted due to these social forces and as a result of institutional pressures—such things as rapid increases in population, family purchasing power, money for loans, and land for suburban homes—transportation supply has not kept pace.

The question for transport policy makers is how the capacity to move freely within the urban region, and in or out of it, can serve to make goals of the urban region easier to attain. Since transportation is the means by which a whole urban area functions and the aspirations of its inhabitants are furthered, freedom to move will in large measure determine whether or not the urban areas will serve their purposes.

2 | Observations

The Committee makes the following observations:

1. Changes in urban transportation should assist in providing efficient economic activity, improved housing and public services, accessible recreational and educational opportunities, and a healthful and pleasant environment.

2. While mobility of people as a whole has been increasing, urban transportation systems, as they exist today in most metropolitan areas,

Contribute to pollution (air pollution, noise pollution, poor esthetic surroundings, social disruption, and the like)

Adversely affect the mobility of those people without access to an automobile

Consume an increasing amount of resources

Result in costly time loss to both passengers and freight shippers at peak hours

3. Institutional and social arrangements at the federal, state, metropolitan, and local levels are such that there is little incentive for coordinated action in simultaneously improving both urban transportation and the efficiency and quality of urban life.

4. Short-run political considerations have intruded into decisions about the technical content of many of DOT's current research, development, and demonstration programs. Moreover, the emphasis of present programs on technology is not balanced by sufficient study of its effects. Given our manifest inability to predict how technology will improve urban life, greater emphasis should be put on improving the understanding of the interactions between transportation and the physical, social, political, and economic characteristics of urban areas.

5. Moreover, it is the Committee's impression that many of the projects in being that might be effective are inadequately funded, are not of critical size, and are of insufficient duration.

6. The Department needs more manpower and a broader range of professional skills to manage its urban transportation research, development, and demonstration programs satisfactorily.

7. The present organizations and groups for study of urban transportation, both within and outside of government, engaged in transportation analysis and research should be strengthened to provide the necessary understanding needed to contribute significantly to urban life.

8. Manpower resources in the United States, if properly used and focused, are sufficient to initiate major activities that could have a significant impact on urban transportation and on the quality of urban life.

3 | Actions

In summary, the Committee feels that our view of urban transportation problems has been too narrow. Our most important need, therefore, is to look at the problem differently, to look at it in each and every relevant frame of reference. This broader approach implies more than trivial changes in our present programs. In consideration of this need, the Committee suggests the following course of action:

1. *Federal urban transportation programs should focus increasingly on providing better quality of urban life, not just better transportation.*

Understandably, this requires additional activity. The scope and scale of the federally sponsored programs need to be expanded sufficiently to demonstrate the influences of different urban development patterns and controls on the need for the various modes of travel and, conversely, the effects of different transportation approaches on the development of urban areas.

The selection process used to determine the size and character of the demonstration programs should (a) consider both the need for development of knowledge and the educational influences of the demonstrations and (b) follow a careful experimental approach. To achieve those goals, a sufficient number of different urban area types and transportation approaches should be included in the demonstration program.

2. *The increasing focus on the quality of urban life clearly calls for a better understanding of the interactions and relationships between urban transportation systems and the functions of metropolitan areas. This, in turn, requires an enhanced program of analysis and real-world experimentation.*

Much of the analysis and experimentation required (such as that outlined in suggested action 3 below) must proceed in sequence and will extend

over many years. In the meantime, the Department can use its existing demonstration program authority to even greater effect. In particular, it might well concentrate even more of its resources in key demonstration project areas such as the following, because of their potential contribution to the understanding of the impact of transportation innovations on urban living and effectiveness of these innovations for users, including the old, the young, the physically handicapped, and the poor:

a. A severalfold increase in the number and size of demonstrations of demand-responsive public transportation systems
b. Large-scale (demonstration) programs of off-street parking tied into existing or planned public transportation systems
c. Additional express bus and busway demonstrations designed to explore the entire range of problems associated with such facilities and operations, as well as the response of the market to them
d. Additional development and demonstration of area traffic control and other network traffic engineering techniques, including such elements as freeway ramp metering systems
e. Major demonstrations for improved activity center distribution, including, but not limited to, exclusive transit streets, pedestrian streets and malls, and "people-movers"
f. Large-scale institutional rearrangements designed to affect the pattern of transport usage significantly, including staggered working hours, increased downtown parking fees, peak-hour auto use taxes, and exclusion of auto movements in high-density areas (with substitute circulation systems)

It is understood that all of the above, and particularly f, require the dedicated cooperation of state and local communities.

3. *The proper design of urban transportation experiments and the implementation of more-effective investment programs also call for an increase in supporting social science thinking and analysis.*

The suggestion here is for more emphasis on supporting work in areas such as those listed below, not for abandoning necessary programs of hardware research and development. It should be noted, further, that research has already been done in these areas, much of it sponsored by the Department and its constituent agencies. Nonetheless, more work—particularly in longer-range predictive situations—is needed in the following areas:

a. Consideration of urban transportation programs and policies, carrying with it the need for a major effort to improve understanding of the costs of transportation, national and local, including
    (i) Internal (auto, fuel, maintenance, insurance, taxes, capital costs, and so forth)

(ii) External (pollution, noise, traffic control, right-of-way, congestion, and the like)

(iii) Natural resources used by present or projected transportation systems, both direct consumption (e.g., fuel) and indirect (e.g., manufacturing of vehicles or construction of roadways or parking facilities)

b. Understanding the effect of alternative urban transportation systems on urban development and improvements in the quality of urban life
c. Delineation of the social impact of transportation alternatives, especially on those elements of the urban population disadvantaged by present systems—the old, the young, the physically handicapped, and the poor
d. Understanding the effect of nontransport policy on transportation demands and system performance—such things as housing and tax policy, zoning and land-use policy, alternative means of recapturing transport benefits, and the fragmentation of local political authority
e. Achieving a better understanding of the spectrum of urban goods movement requirements and the institutional problems associated with improved goods movement technology

In attacking the problems just described, the work should be conducted within a social science frame of reference, applying the concepts, insights, and findings of social science (sociology, political science, anthropology, psychology, and economics) and including researchers trained in the social sciences as consultants to engineering research projects. Social research to provide an understanding of underlying social mechanisms relevant to transportation, to monitor ongoing systems, and to contribute to the design of social–technical policy for transportation should be specifically included.

4. *Adequate support of increased Department of Transportation research, development, and demonstration activity requires further strengthened professional capability both inside and outside the Department.*

a. In particular, DOT should continue to support the formation and development of concentrations of competent professional activity for research, for monitoring demonstrations, and for training.
b. In allocating support for such concentrations, the overall emphasis should be on critical size and quality, rather than on a large number of small groups.
c. As described in suggested action 3, these concentrations should include more professionals trained in the social sciences for interdisciplinary work with the engineers who have heretofore borne the principal responsibility for urban transportation research.
d. To the extent feasible, these concentrations or groups should include people from academic, government, political, and industrial back-

grounds, in order to provide stimulation for and to facilitate inclusion of the consideration of "real-world problems" within the research programs.

e. The Department should support more education activity in areas related to urban transportation development and planning.

5. *With increased and improved resources and higher levels of activity, the Secretary will be able to make specific assignments of responsibility within the Department for implementing a more effective program of research, development, and demonstration in urban transportation.*

The Department's programs as presently structured and funded are not likely to make a sufficient contribution to an improvement in the urban quality of life. They need increased funding and commensurate broad and continuing evaluation and review.

The Committee, therefore, suggests that the Secretary assign to some specific officer the responsibility for developing detailed plans to implement the foregoing recommendations and to arrange for a continuing review of progress.

The Committee suggests with real urgency that:

a. The implementation of the programs to carry out the activities related to experiments with different urban areas and with different transport systems detailed in suggested action 1 poses difficult institutional coordination and management problems and therefore should be so assigned as to ensure that full energy and resources are brought to bear forcefully to accomplish that implementation. The DOT should ensure that a set of large-scale urban area demonstration programs are undertaken involving public and private ventures. These should include establishing what improvements in urban forms are possible, identifying the measures to be applied to determine demonstration performance, selecting a level of expenditure for procuring a preliminary set of proposals, conducting a competition for demonstration programs, and selecting the sites on the basis of established criteria.

b. Improved and expanded institutions in support of urban transportation should be established through the Office of the Secretary. In this regard, the Committee supports the efforts of the Department to establish a program for an increased level of university research and advanced study, as is being proposed within the formulation of the FY 1973 budget. Specifically, in the Urban Mass Transportation Administration (UMTA), the existing funding under Section 11 of the Urban Mass Transportation Act should be increased, and these funds should be allocated primarily to a small number of institutions where effort can be concentrated rather than spread uniformly over a

large number of locations. The activities of these places should be expanded and broadened to include the various subjects that the Committee has specified.

d. The Office of the Secretary should ensure that the necessary analyses and data specified in suggested action 3 be obtained. Each of the major modal agencies should participate in obtaining the information, and UMTA should significantly expand its efforts in this regard. While the various centers for research should be used as a means of obtaining the data and making the analysis, explicit contracts for analysis, simulation, and evaluation may need to be arranged in some cases.

6. *With improved knowledge and increased resources, the Department of Transportation could take the lead in encouraging state and local jurisdictions to accomplish program designs and should consider doing so. The program could involve the overall physical and institutional transformation of a single metropolitan area—or several areas—as a demonstration of how changes in transportation can help fulfill broader social and urban objectives.*

For example, the Department of Transportation, the Department of Housing and Urban Development, the Department of Health, Education, and Welfare, and the Environmental Protection Agency could join in planning, and joint funding might be used to support design competition by up to ten urban areas in each of three size classifications—large, medium, and small—that could include new communities as well as established ones. The result of the design competition would be the selection of the best proposals for implementation. The Committee notes that some effort along these lines is currently under way as part of the Urban Growth and New Communities Development Act of 1970 and that additional actions are proposed in community development legislation now pending in Congress. The Committee considers its suggestion to be consistent with and an extension of the intentions outlined in the existing and proposed legislation. The nature of the suggested city-wide demonstration is based on planned cities and urban renewal projects around the world, the lessons of which illustrate the possibilities of successful urban reconstruction and planned suburban growth.

Features of community design that should be applied to new urban areas, to central city reconstruction, and to the growth of the suburbs are as follows:

- Good housing should be located close to employment to reduce average home-to-work travel distance.

- Industrial estates can now make good neighbors and should be located where they are accessible to residential areas.
- Community facilities should be convenient to housing.
- Pedestrian-oriented clusters of activity with ample parking and transit can help to organize high-density local movement.
- Underground freight delivery should be provided for at major shopping centers and districts.
- High-quality public transit should be designed to serve all areas of the community.
- Major highways and transit services should connect clusters of development, thus solving part of the urban traffic problem by essentially intercity methods.
- Institutional arrangements are needed for public land acquisition to permit large-scale development and to provide for the recoupment of increased land values to help finance housing and community services.
- Open space and low-density land uses need to be provided for or preserved in cities to limit urbanization and the concomitant pollution of the land.
- Communities should be designed or redesigned to decrease the percentage of urban areas devoted to streets and to reduce the norm of travel required per capita, thereby reducing the proportion of urban resources required to support transportation.
- Street landscaping and control of commercial encroachments is essential to reduce urban land pollution.

Additional suggestions relating to implementation of these ideas are included in Appendix A.

4 | Closure

Much of the material presented above is admittedly derivative in nature. There have been other studies in the past. Our suggestions for research and development are coupled with a realization and awareness that there are many programs under way already.

Yet the problems are staggering. It is clear that in recent years conventional transportation investments in the cities have not met with notable success. A central idea that this report may contribute toward solution of the transportation problem is this: Given the new focus of transportation as it relates to urban goals, the mission of the Department of Transportation should be looked upon as involving transportation not simply as a way to move but rather as a means of helping to create a better urban society. The Department has the resources to help initiate new approaches to urban transportation, approaches that can help to rebuild the inner cities and to guide new growth toward the kind of urban environment in which residents can lead their lives in safety, with convenient access to the various sites of value within and outside the city that make life rewarding and enjoyable.

APPENDIX

A Urban Design—A Typical Program

A research, development, and demonstration program should be conducted to design new communities or to convert existing urban areas, or both, to make them model communities through a combined program of transportation, housing, urban planning or renewal, and regional planning.

Satisfactory urban transportation solutions depend to an important degree on the design and arrangement of the city, on the creation of an attractive environment, and on a desirable growth policy. More satisfying urban communities depend to an important degree on the design of transport systems, including the effective use of transport infrastructure as an aid to good urban design and environment.

A multidisciplinary team should be assembled to study the requirements of a new community and the physical conditions of existing urban areas, the alternative goals for the future, and the institutional changes necessary to bring about a high-quality urban environment.

The federal government should sponsor a combined program of transportation, housing, health, education, recreation, and other services by pooling resources for design of the new communities and design for reconstruction of selected urban areas. Industry participation should be sought. The organization and procedures for management and coordination should be established after further study, but one arrangement might include direction of the program through the Domestic Council.

The following specific steps are illustrations of what the program would include:

1. The street system would be designed to optimize the land use or, in the case of existing urban areas, would be redesigned over a period of years to reduce unnecessary mileage and make the land available for other uses. If new city designs can be used as a guide, it may be possible to convert as much as half of the area now devoted to streets to serve a number of other useful purposes.
2. Efficiently designed or redesigned street systems should provide large tracts of land that could be allocated for campus-type housing developments, educational centers, industrial estates, and shopping centers.
3. The remaining mileage of streets could be landscaped (as rural highways have been) to provide an esthetically attractive network, by removing utility poles and wires, creating utility trenches, providing street lighting, and planting trees and other greenery. Main streets could be constructed as boulevards, following the example of rural highway roadside development.
4. More of the central area of the city could be devoted to housing for various income groups, with land acquisition made possible through the new city provisions of the Housing Act of 1970.
5. New zoning laws should be enacted to avoid or eliminate commercial development along main highways, and alternative solutions should be provided by assembling commercial facilities into shopping centers with underground truck deliveries and parking.
6. Street parking could be prohibited, and space could be provided in small, frequent, off-street facilities to meet parking requirements. Electronic controls would facilitate traffic movement.
7. Demand-actuated transportation systems would be designed to meet the needs of various urban services, particularly to and from shopping, schools, and recreations.
8. A city-wide system of staggered hours could be inaugurated, based on study of the city's economic activities and the possibilities of departing from conventional work hours through a reduction in work days per week, hours per day, and staggered hours through weekends. Demonstrations would measure the impact on peak-hour traffic, the savings in public investment, and the effects on worker productivity and business.
9. Redevelopment plans and new urban developments would seek to arrange housing and employment areas to reduce the length of work trips for those people desiring such a change.
10. Charges for the use of automobiles would be considered on the basis of the total costs of accommodating automobile traffic, including social costs.

11. Specialization in the use of streets would be sought, including the identification of a network of streets for the exclusive use of public transportation systems.

12. Low-cost jitney service, more extensive taxi service, dial-a-bus, and other systems would be integrated into the urban plan.

13. Large areas in the downtown center might be closed to traffic. With vehicle storage and transit underground, pedestrian transport on the surface would be aided by newly developed people-distribution systems.

14. Clusters of mixed land uses would be built to accommodate apartments, townhouses, offices, stores, and cultural and recreational facilities.

15. Cable television could be installed for two-way interactive information systems and for the introduction of transport-saving educational, medical, and banking services.

16. The new housing and environmental achievements in existing built-up areas would need to be preserved by measures dealing with further growth. The Federal Highway Act of 1970 provides for highway access to new growth centers; acquisition of land for new satellite cities is provided for in the Federal Housing Act. These two programs might be combined and expanded to create the areas for renewal or new growth. A regional plan for multiple centers of activity connected by transport facilities could create the multicentered regional metropolis of the future, combining the economies of the big city with the human scale of the neighborhood and small community.

APPENDIX

B Résumés of Source Documents

The members of the Committee have had available to them many reports from individuals and organizations and have held discussions with many individuals within and outside of government who are expert in the subject of urban transportation and urban development. As indicated by their affiliations and backgrounds (Appendix C), the members are from industry, government, business, and educational institutions and other not-for-profit institutions. A number have previously served in positions in government. The observations and actions presented in this report represent the opinions and insights of this Committee. The content of the report is viewed not as a research report but as an expression of the combined judgment of the members. As a part of this process of review and judgment, a number of papers, presentations, and reports were considered by the Committee. The Committee does not endorse these references; rather, it found them useful in developing judgments. Those portions of these references specifically cited in the body of the report are considered authoritative by the Committee, but this should by no means be construed as approval or disapproval of the reference itself.

For the convenience of the reader, short résumés of the material covered in certain of the working papers, presentations, and reports are included here. The working papers were prepared in August 1971; the consultants' reports were prepared in July 1971; and the individual presentations were made on March 4, 1971. Copies of the complete text of these materials are retained in the Committee's files.

WORKING PAPERS

The Problem

The elements of the difficulties being experienced in urban areas are discussed briefly. Mounting costs, declining service, increasingly damaging side effects, inadequate institutional arrangements, and deficiencies in planning are described. An outline is given of needed actions to improve the situation.

Peak-Hour and Congestion Problems

The relation of peak-hour travel to off-hour travel associated with work trip travel for transit and highway systems is discussed. Statistical comparisons are made for a number of cities and for various times of day to illustrate the problem.[6] A number of alternatives to present arrangements are cited, and research is recommended to improve analyses of data and methods for evaluation of these alternatives. (See Figure B-1 and Tables B-1 and B-2.)

Availability (and Suitability) of Urban Transportation

The unavailability of transportation to a segment of this country's urban population is described. Reasons for the condition are considered—for example, automobile–highway-oriented systems in some areas with reduced

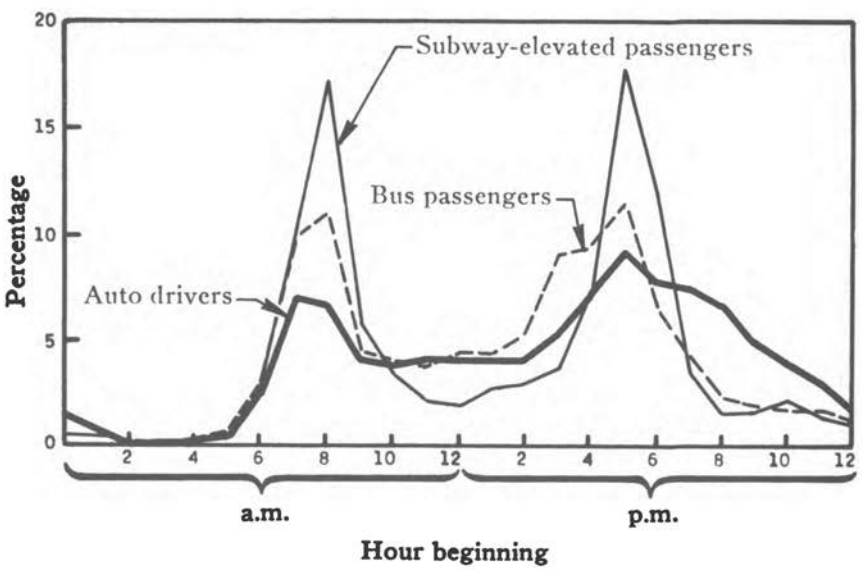

FIGURE B-1 Hourly distribution of trips by mode, Chicago 1956. (Reprinted with permission from Meyer *et al.*[6])

public transit and resulting reduced availability of transportation to the old, young, disabled, or poor; and public transportation in many areas where it is either poorly located to serve demand or too expensive.

Lack of uniformity, lack of balance, and importance of transportation to sound urban design and development, as well as the need to develop public support for suitable transportation systems, are cited.

Greater incentives are urged for stimulating use of transportation and for developing an effective constituency for support of improved urban transportation.

The Increasing Market for Urban Mass Transportation

The paper states that the long-range trend has been a decrease in the total number of passengers carried by public transit agencies, but notes that there are now signs indicating that the trend may be leveling off.[3] The continual rise in the number of passenger-vehicle-miles in urban areas is cited.[4] The increasing proportion of the population age 65 or over and the effect of the increasing costs of automobile operation, particularly on the

TABLE B-1 Approximate Percentage of Transit Passengers or Vehicular Volume Traveling during Peak Hours in Selected Cities[a]

System and City[b]	Percentage of Daily Volume	
	During Four Peak Hours	During Maximum Peak Hour
Bus transit systems		
Chicago	40	—
Washington, D.C. (3 major lines)	53	16
Rail rapid transit systems		
Boston	44	—
New York City	49	14
Chicago	58	16
Toronto	51	18
Cleveland	58	19
Philadelphia	58	17
Railroad commuter systems		
Chicago	72	25
Washington, D.C. (Pennsylvania RR)	68	23
Philadelphia (Pennsylvania RR)	68	25
Highway systems		
Chicago	32	9
Detroit (Lodge-Ford Expressway)	28	7
Chicago (Congress Street Expressway)	30	8
Washington, D.C. (Memorial Bridge)	44	13
Boston (Route 128)	29	9

[a]Reprinted with permission from Meyer *et al.*[6]
[b]Based on available data for 1959–1962 period.

TABLE B-2 Percentage of Total 2-Way Hourly Flow Proceeding in Minor Direction during Maximum Rush Hour, at Maximum Load Point[a]

System and City	Percentage of Flow in Minor Direction
Rail transit	
Toronto, p.m., 1962	19.5
New York, p.m., 1961	13.5
Cleveland, p.m., 1961	16.0
Philadelphia, p.m., 1961	23.0
Chicago, p.m., 1960	19.5
Bus transit	
Washington, D.C. (3 lines), p.m., 1959	21.0
Railroad commuter	
Philadelphia (Pennsylvania RR), p.m., 1958	15.1
Highway systems	
Detroit (Lodge-Ford Expressway)	42.6
Chicago (Congress Street Expressway)	37.4
Washington, D.C. (Memorial Bridge)	36.3

[a]Reprinted with permission from Meyer *et al.*[6]

poor, are described. The possibility is discussed that the potential urban transit market may now be on the verge of increasing. (See Table B-3 and Figures B-2 and B-3.) The suggestion is made that increased auto operation costs may force more of the poor to depend on public transit and thereby further increase the need for adequate public systems.

Functional and Social Aspects of Transportation

Work, recreation, shopping, and travel for medical purposes all are factors entering into the problem of urban design, which includes urban trans-

TABLE B-3 Percent Distribution of Family Units without Autos by Income Group[a]

Income before Taxes	Family Units without Auto			% Change
	1965	1967	1969	1965–1969
< $1,000	73	75	68	−6.8
$1,000–$1,999	57	62	61	+6.8
$2,000–$2,999	44	47	54	+22.5
$3,000–$3,999	32	37	46	+44.0
$4,000–$4,999	24	24	32	+33.3
$5,000–$5,999	18	18	21	+16.8
$6,000–$7,499	12	14	12	0
$7,500–$9,999	6	7	7	+16.7

[a]Data from 1970 Automobile Facts and Figures and the University of Michigan Research Center, Survey of Consumer Finances.[4]

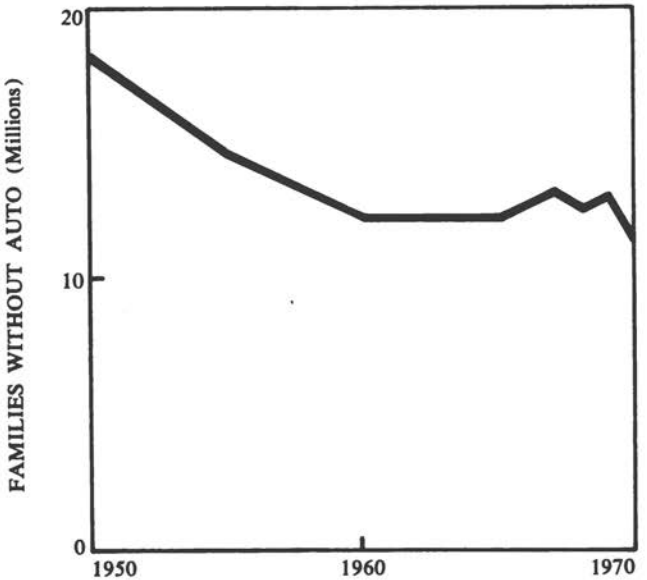

FIGURE B-2 Number of families without automobiles as a function of time. (Data from Statistical Abstract of the United States: 1971.[28])

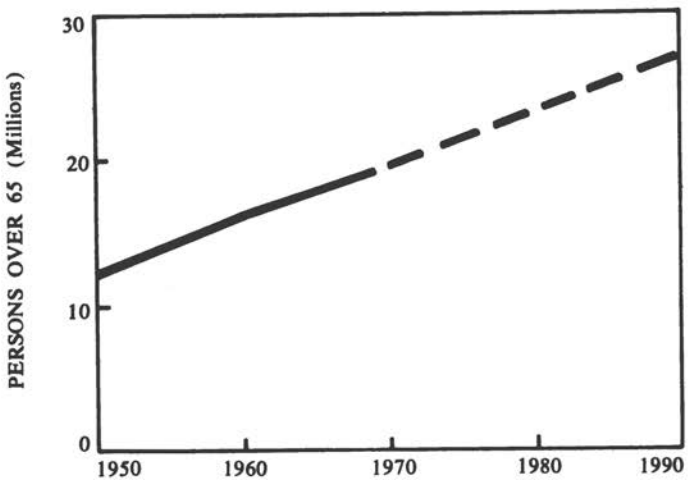

FIGURE B-3—Number of persons over age 65 as a function of time. (Data from Statistical Abstract of the United States: 1971 to 1970.[28] 1980 and 1990 are estimated).

portation. The institutional and social actions, incentives, and restraints are cited and reasons for the auto–highway-oriented urban patterns are discussed. The suggestion is made that the solution to many urban problems and the way to improved quality of urban life lie in acquisition of necessary

knowledge through interdisciplinary research that includes emphasis on social and institutional problems. A necessary part of the conduct of such research would be meaningful demonstration projects of scope and scale sufficient to prove and improve existing theories and to provide the data for improved urban and transportation design.

Transportation Research as Social Research

From the point of view of social analysis, the paper notes that transportation is a social activity. The significant requirement is that the behavior of people be conceptualized using the analytic tools of the social sciences. The observation is made that social research may have the objective of explaining and predicting ongoing systems, monitoring existing systems, or contributing to an improved management policy. The functions fulfilled by transportation and definition of the internal characteristics of transit systems are described. There is discussion of an understanding of the decline in use of mass transit and of the relation of transit to welfare or poverty problems.

Current Urban Transportation Research and Development

The observation is made that, until recently, most urban transportation research and development was supported by the private sector. However, governmental activities at various levels had a large indirect effect on character, mode, and technology of urban transportation through granting of franchises, building of roads and streets, construction of the interstate highway system, and the FHA mortgage loans for single-family developments. It is noted that private incentives for improvement of urban mass transportation have almost been eliminated. Federal expenditures in FY 1971 for urban transportation research were estimated at about $25 million. Private investment in urban transportation R&D was estimated at about the same level. The paper observes that very little R&D effort is aimed at integrating transportation developments into the building of new cities, determining urban transportation costs, or developing the institutions and professional groups needed for an effective program. The multidisciplinary urban transportation research and development funding for FY 1971 is estimated at only $23 million.

Factors Involved in Urban Development

This working paper notes the generally accepted view that an interdisciplinary, multimodal approach is necessary for solution of urban transportation and urban development problems.[8,13] It provides background concerning the diversity of the problems facing the many urban areas and the necessity for several sets of policies and solutions is outlined. A number of problem areas related to urban development and urban transportation are discussed.

Population The population of the United States today is about 207 million, with two thirds of the people living in urban areas. By the year 2000, it is estimated that the population will be 270 to 310 million, with about 70 percent, some 190 to 218 million, in urban areas. A forecast of the distribution of the higher number is shown in Figure B-4.[16,18,19] It is observed that no one type of expansion will be sufficient, but the country will require expansion of existing cities and suburbs as well as construction of new cities to provide the room for these additional people to live and work. Efficient urban planning, taking into account all urban service needs and making maximum use of transportation as a tool where needed, will be required to provide for the expected growth.

Housing There were 60 million homes in the United States in 1960, and new starts in the past 10 years have averaged only about 1.5 million per year. Housing distribution toward the suburbs has given rise to more auto traffic and more congestion. The report of the President's Committee on Urban Housing, *A Decent Home,* recommends 26 million more homes, including 6 million subsidized units, requiring some 8 million acres of land over the next 10 years (Table B-4).[22] The experience gained in this country and abroad—in Brazil, Britain, Sweden, Italy, India, Singapore, and the Philippines—offers information on all developmental factors over a wide

FIGURE B-4 Twelve urban regions projected by the year 2000. (From National Goals Research Staff.[19])

TABLE B-4 Past and Projected Housing Starts and Publicly Assisted Rehabilitation, by Fiscal Year (in thousands)[a]

Fiscal Year	Total Housing Starts[b]	Private Unassisted New Housing Starts and Rehabilitation			Publicly Assisted Housing Starts	Total Housing Starts and Publicly Assisted Rehabilitation	Publicly Assisted New Housing Starts and Rehabilitation			
		Total[b]	Starts	Rehabilitation			Total Publicly Assisted Starts and Rehabilitation	Public Rental Housing	Private Rental Housing	Private Home Ownership
1959	1,469	1,418	(c)	(c)	51	1,469	51	51	—	—
1960	1,420	1,386	(c)	(c)	34	1,420	34	34	—	—
1961	1,286	1,233	(c)	(c)	53	1,286	53	53	—	—
1962	1,445	1,402	(c)	(c)	43	1,446	44	42	2	—
1963	1,563	1,526	(c)	(c)	37	1,564	38	31	7	—
1964	1,638	1,591	(c)	(c)	47	1,638	47	32	15	—
1965	1,527	1,469	(c)	(c)	58	1,528	59	40	19	—
1966	1,433	1,384	(c)	(c)	49	1,435	51	32	18	1
1967	1,112	1,661	(c)	(c)	51	1,117	56	30	23	3
1968	1,520	1,407	(c)	(c)	113	1,535	128	67	53	8
Total	14,413	13,877	(c)	(c)	536	14,438	561	412	137	12
1969	1,700	1,450	1,400	50	250	1,750	300	75	125	100
1970	2,000	1,700	1,650	50	300	2,100	400	130	140	130
1971	2,100	1,750	1,650	100	350	2,250	500	190	160	150
1972	2,300	1,950	1,800	150	350	2,500	550	200	200	150
1973	2,550	2,150	2,000	150	400	2,750	600	200	250	150
1974	2,700	2,250	2,150	100	450	2,950	700	200	350	150
1975	3,000	2,550	2,350	200	450	3,250	700	150	400	150
1976	3,300	2,800	2,500	300	500	3,600	800	150	450	200
1977	3,300	2,800	2,500	300	500	3,550	750	100	450	200
1978	3,250	2,800	2,500	300	450	3,500	700	100	400	200
Total	26,200	22,200	20,500	1,700	4,000	28,200	6,000	1,495	2,925	1,580

[a]From President's Committee on Urban Housing,[22] p. 48. Data from Department of Housing and Urban Development.
[b]Includes unassisted privately rehabilitated units, but not publicly assisted.
[c]Not available; the total consists of new unit starts.

range of city size, density, income, and level of technology. It is noted that transportation can be used constructively with good urban planning to promote new housing and communities, as well as to accommodate to existing patterns where necessary.[1,8,17,24,25,26]

Environment Increasing public awareness and the enactment of legislation requiring consideration and reporting of environmental factors all bring change, but environmental problems are still severe. Every 20 years, American industry doubles the amount of chemical waste it discharges into water; thermal pollution from power production is increasing at about the same rate as generation of electrical power, or about 7 percent per year; and municipal waste-treatment plants serve only 55 percent of our present urban population. Traffic noise in urban areas may be over 90 decibels (for example, heavy trucks at 50 feet), while some construction noises are even greater (Figure B-5). Total air pollution amounts to something over 280 million tons per year and is still increasing at over 3 percent a year. The Environmental Protection Agency estimates that the annual toll of air pollution on health, vegetation, materials, and property values is more than $16 billion per year. The agency further estimates that a 50 percent reduction in air pollution would reduce damage to health by one third, or over $2 billion. The direct costs for pollution abatement are shown in Table B-5 and are expected to be as much as $105 billion for the period 1970–1975.[15,23]

Cost and Financing of Transportation Transportation accounts for about 20 percent of the U.S. Gross National Product (GNP), in 1969 amounting to $186.4 billion (Table B-6).[27] The Department of Transportation estimated on September 17, 1971, that total expenditures for domestic transportation in 1970 were some $190 billion. About $155 billion was highway-related, with over half of this related to urban areas. Of the $35 billion related to rail, water, air, or pipeline transportation, something in excess of two thirds is urban-connected. It is estimated that the urban portion is about $102 billion. Such associated costs as the $7 billion insurance losses paid can be determined, and air pollution costs due to transportation of some $7 billion can be estimated, but the prices on human life and suffering, time loss, and urban esthetics are not well determined.[20,23,28] Although some of those costs are difficult to isolate and not all are included in the total, it is estimated that some 15–20 percent of the urban transportation bill might well be attributed to indirect and social costs.

The point is made in public hearings throughout the country that funding problems are essentially institutional and political in nature. Improved funding arrangements are essential to achieving more effective transportation. One possible approach involves an equitable division of costs among

TABLE B-5 Pollution Abatement Cost Summary (in billions of dollars)[a]

Pollutant/Medium	1970			1975			Cumulative Requirements 1970–1975		
	Capital Investment		Annualized Costs	Capital Investment		Annualized Costs	Capital Investment	Total Operating Costs	Total Expenditures
	Cumulative[b]	Annual		Cumulative[c]	Annual				
Air pollution									
Public[d]	$ 0.2	$0.1	$0.2	$ 0.5	$0.1	$ 0.2	$ 0.4	$ 1.2	$ 1.6
Private									
Mobile	.1	.1	−.2	4.3	2.9	1.5	5.4	.6	6.0
Stationary	1.0	.7	.5	7.7	1.8	3.0	8.0	8.1	16.1
Total	1.3	.9	.5	12.5	4.8	4.7	13.8	9.9	23.7
Water pollution									
Public									
Federal[e]	NA	NA	.2	.3	.1	.3	.3	1.3	1.6
State and local									
Treatment systems	13.7	1.2	1.6	24.2	1.5	3.3	13.6	9.3	22.9
Collecting sewers[f]	(12.0)	NA	NA	(12.0)	NA	NA	(3.6)	NA	(3.6)
Combined sewers[g]	NA	NA	NA	NA	NA	NA	(15.0–48.0)	NA	(15.0–48.0)
Private									
Manufacturing	3.9	.8	1.1	7.1	.6	1.9	4.8	7.2	12.0
Other	.9	.3	.2	1.1	.1	.3	.5	1.0	1.5
Total	18.5	2.3	3.1	32.7	2.3	5.8	19.2	18.8	38.0

Solid Waste[h]									
Municipal									
Public	NA	.1	2.1						
Private	NA	NA	2.3	NA	.3	7.8	1.5	42.0	43.5
Industrial	NA	NA	1.3						
Total	NA	.1	5.7	NA	.3	7.8	1.5	42.0	43.5
Grand Total	NA	3.3	9.3	NA	7.4	18.3	34.5	70.7	105.2

[a]For major air, water, and solid waste pollution control expenditures.
[b]Total capital in place as of the end of 1970.
[c]Total capital in place as of the end of 1975 is net of depreciation for the period.
[d]For construction and operation of federal facilities only.
[e]For construction and operation of federal facilities only. Does not include the federal construction grant funds, which are included under state and local.
[f]Collecting sewers are shown as a non-add item due to lack of data.
[g]Combined sewers shown as a non-add item because of lack of data.
[h]Annualized costs exclude depreciation and interest because of lack of data.
Source: Based on Environmental Protection Agency data.

TABLE B-6 The Nation's Estimated Transportation Bill (billions of dollars)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969(P)
Passenger Bill[a]	54.7	57.8	55.9	61.6	64.8	69.3	78.1	81.9	85.0	96.0	104.3
Freight Bill[b]	47.3	47.6	49.3	52.6	56.0	60.6	64.5	68.6	72.6	76.8	84.0
Totals	102.0	105.4	105.2	114.2	120.8	129.9	142.6	150.5	157.6	172.8	188.3
Adjustments[c]	.3	−.9	−.1	−.2	−.3	−.3	−1.0	−.8	−.6	−.7	−1.9
Adjusted Totals	102.3	104.5	105.1	114.0	120.5	129.6	141.6	149.7	157.0	172.1	186.4
GNP[d]	483.7	503.7	520.1	560.3	590.5	632.4	684.9	749.9	793.9	865.0	931.4
Percent Trans. of GNP[e]	20.64	20.21	19.67	19.84	20.04	19.90	20.05	19.34	19.17	19.32	19.41

[a]Data from U.S. Department of Commerce, OBE, July 1970, "Survey of Current Business"; Interstate Commerce Commission, 1969, "Transport Statistics"; Civil Aeronautics Board, 1969, "CAB Air Carrier Financial Statistics."
[b]Data from Interstate Commerce Commission, 1969, "84th Annual Report"; 1969, "Transport Statistics in the U.S."; 1971, "Transport Economics"; Civil Aeronautcis Board, 1969, "CAB Handbook of Airline Statistics."
[c]Government expenditures not included in passenger or freight transport outlays, less duplications.
[d]Data from Council of Economic Advisers, Jan. 1971, "Economic Report of the President."
[e]Percentage computation excludes from the "Adjusted Totals" interest on the debt for private automobile, which is no longer considered as part of GNP.

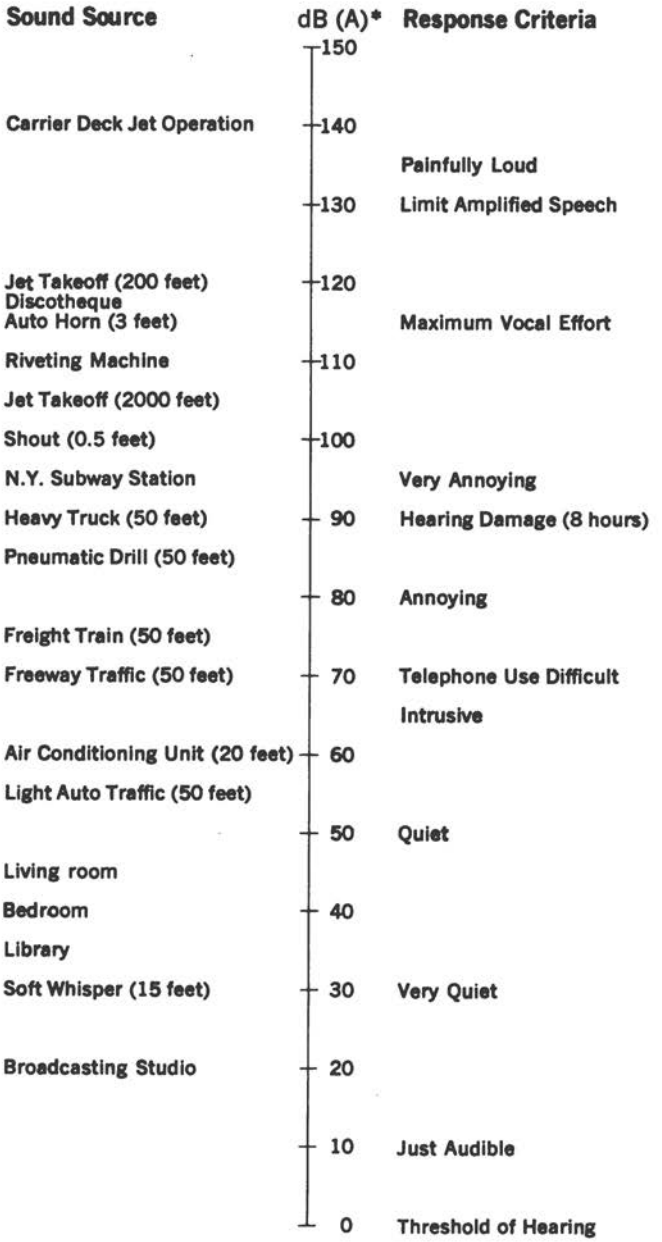

FIGURE B-5 Weighted sound levels and human response. (From Environmental Quality, The First Annual Report of the President's Council on Environmental Quality, together with the President's Message to Congress, August 1970, p. 125.)

passengers, neighboring property owners, businessmen, and citizens. Figure B-6 illustrates the concept.

The need for improved public transport financing is increasingly recognized at all levels of government, but each case must include recognition of public preferences, local priorities, economic capabilities, and government attitudes. Fiscal policies and institutional arrangements need to be improved to help provide balanced financing for transportation systems.

Urban Mobility America has built a different type of city in this century, bearing little resemblance to traditional European cities. The new city, metropolis, has many centers, rather than one. The major center and diverse suburbs are interdependent. From 1954 to 1965, according to the Bureau of Labor Statistics, 63 percent of all new industrial buildings were constructed outside the core cities, and 70–80 percent of the new jobs in trade and industry are being created in the metropolitan fringe. Prosperity, the automobile, and public policy all contributed to this pattern of development. Automobiles have played an increasing part. Some 80 percent of all families now own cars, a 40 percent increase in less than 15 years. The number of two-car families has increased by a factor of four in that period. Currently, some 98 percent of the people trips and nearly 100 percent of the goods movement are by car, bus, or truck. However, for those without

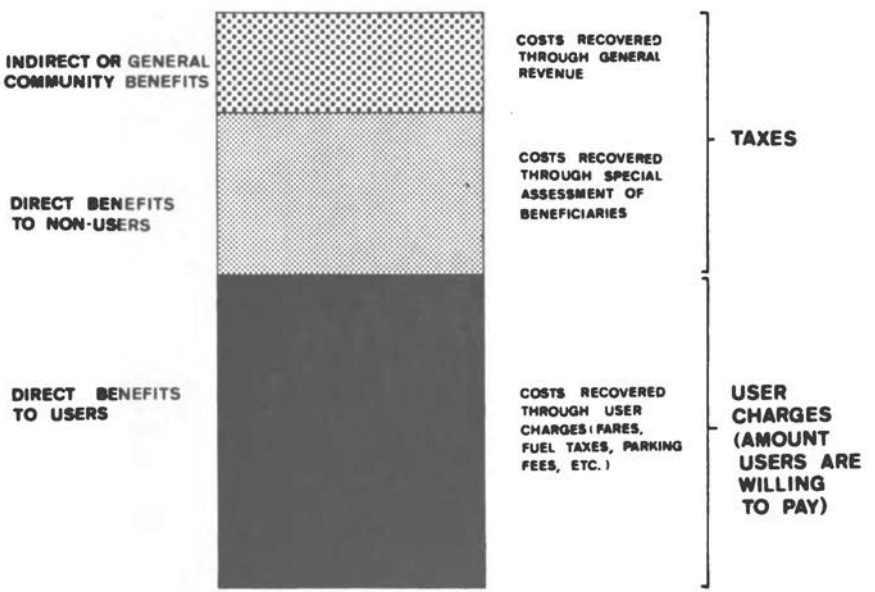

FIGURE B-6 The concept of cost recovery. (From Center City Transportation Project: Financing Public Transportation, p. 31.)

cars or without adequate public transportation, for the old, the young, the handicapped, or the poor, there is still inadequate service for their need to have mobility for work, shopping, medical care, and recreation.

Social Ills The overall incidence of crime in the United States has increased markedly in the last decade, as shown in Figure B-7. For cities with population of 250,000 or over, the crime rate per 100,000 population has increased from 1,922 in 1967 to 2,235 in 1968 to 2,471 in 1969 (Table B-7). Crime of the type related to transportation generally has been on

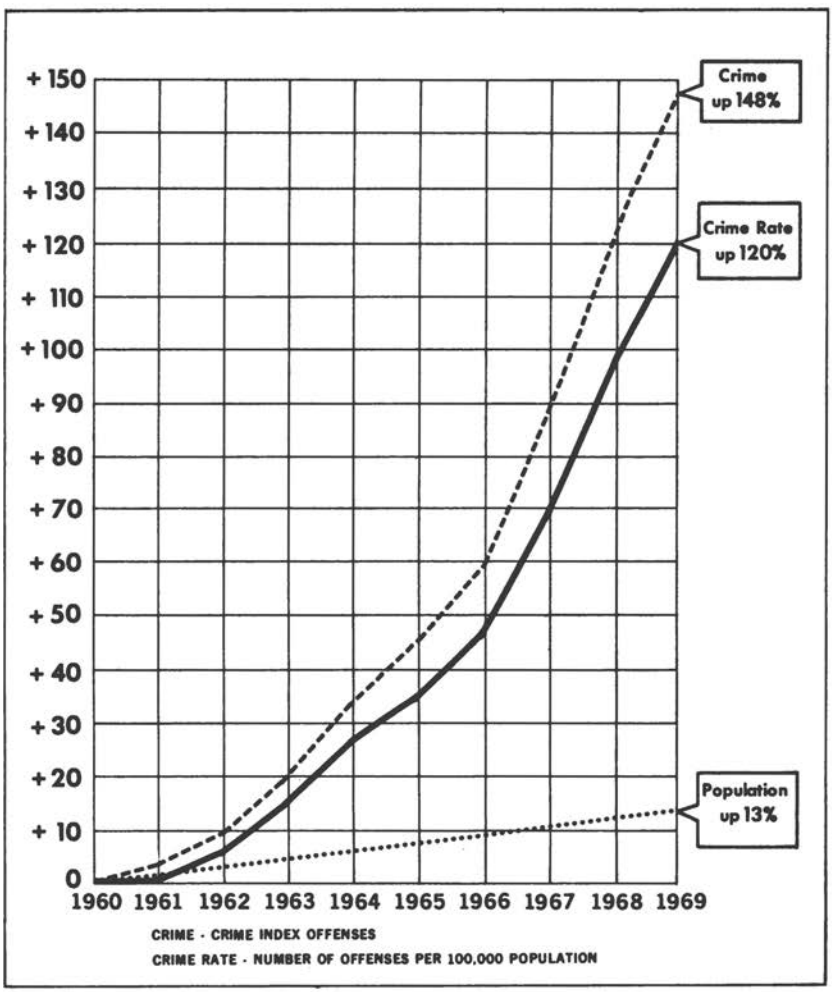

FIGURE B-7 Crime and population, 1960–1969. (Federal Bureau of Investigation chart.)

TABLE B-7 Crime Rate per 100,000 Population in Standard Metropolitan Statistical Areas (SMSA's) with Populations of 250,000 or More[a]

	SMSA	CRIME RATE PER 100,000 POPULATION [1]									
					Violent crime, 1969				Property crime, 1969		
		Total, 1967	Total, 1968	Total, 1969	Murder and nonnegligent manslaughter	Forcible rape	Robbery	Aggravated assault	Burglary	Larceny, $50 and over	Auto theft
1	**United States**	**1,922**	**2,235**	**2,471**	**7.2**	**18.1**	**147**	**152**	**966**	**749**	**432**
2	**SMSA's, 250,000 or more †**	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
3	Akron, Ohio	2,173	2,402	2,602	5.7	21.0	128	120	857	889	582
4	Albany-Schenectady-Troy, N.Y.	1,257	1,285	1,388	1.8	6.8	39	55	610	338	338
5	Albuquerque, N. Mex	(NA)	(NA)	5,018	5.1	39.9	142	322	2,179	1,638	692
6	Allentown-Bethelem-Easton, Pa.-N.J.	868	1,024	1,182	2.4	7.0	22	66	485	452	148
7	Anaheim-Santa Ana-Garden Grove, Calif.	2,468	2,951	3,341	2.5	20.6	87	102	1,463	1,344	323
8	Atlanta, Ga	2,000	2,431	2,805	16.5	24.8	106	147	1,112	905	494
9	Bakersfield, Calif	3,018	3,219	3,306	8.7	20.7	88	146	1,290	1,396	257
10	Baltimore, Md	3,568	4,449	4,256	13.4	41.6	468	500	1,348	1,126	760
11	Beaumont-Port Arthur-Orange, Tex.	1,302	1,832	2,117	6.3	10.7	82	261	1,056	496	205
12	Binghamton, N.Y.-Pa	841	1,025	1,063	2.0	7.6	21	24	569	340	99
13	Birmingham, Ala	2,007	2,198	2,285	16.9	19.8	61	268	801	792	326
14	Boston, Mass. SEA	1,993	2,534	2,835	4.2	13.3	122	90	982	669	954
15	Boston, Mass. SMSA	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
16	Bridgeport, Conn. SEA	1,790	2,276	2,630	2.9	6.8	82	71	1,049	976	443
17	Bridgeport, Conn. SMSA	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
18	Buffalo, N.Y	1,856	1,964	2,171	4.4	14.1	110	100	792	725	426
19	Canton, Ohio	(NA)	(NA)	1,764	3.0	12.2	86	52	554	802	254
20	Charleston, S.C	1,824	2,101	2,482	14.0	21.8	102	172	1,070	674	429
21	Charleston, W. Va	1,204	1,478	1,434	5.3	4.9	48	91	575	555	155
22	Charlotte, N.C	2,457	2,939	3,447	18.6	20.1	118	587	1,412	977	314
23	Chattanooga, Tenn.-Ga	2,096	2,460	2,643	13.3	13.6	149	82	1,278	397	712
24	Chicago, Ill	2,298	2,458	2,680	11.6	24.7	340	242	808	609	645
25	Cincinnati, Ohio-Ky.-Ind	1,372	1,570	1,780	7.3	17.3	84	90	712	612	257
26	Cleveland, Ohio	1,914	2,251	3,162	13.8	17.9	290	131	836	579	1,295
27	Columbia, S.C	2,032	2,535	2,884	14.1	17.7	104	236	1,252	751	510
28	Columbus, Ohio	2,235	2,766	3,037	5.9	35.3	166	105	1,172	1,006	547
29	Corpus Christi, Tex	2,549	2,576	3,077	6.3	15.6	64	279	1,231	1,128	354
30	Dallas, Tex	2,022	2,312	3,701	18.1	34.2	184	293	1,668	901	602
31	Davenport-Rock Island-Moline, Iowa-Ill.	1,614	1,662	1,877	2.1	13.5	60	71	794	664	272
32	Dayton, Ohio	1,708	2,072	2,392	8.5	15.4	144	131	968	731	394
33	Denver, Colo	2,326	3,133	4,095	6.9	41.5	173	191	1,534	1,368	780
34	Des Moines, Iowa	1,639	1,982	2,415	3.6	13.8	93	45	774	1,089	398
35	Detroit, Mich	3,444	3,612	4,283	13.0	35.7	477	220	1,566	1,183	788
36	Duluth-Superior, Minn.-Wis	1,476	1,569	1,726	0.7	7.3	26	53	806	567	277
37	El Paso, Tex	2,098	2,268	2,430	4.5	12.3	64	117	1,164	590	480
38	Erie, Pa	1,295	1,256	1,181	1.5	8.9	55	56	517	362	182
39	Flint, Mich	2,528	2,585	3,164	8.0	25.8	190	346	1,139	1,156	299
40	Fort Lauderdale-Hollywood, Fla.	2,779	3,099	3,688	14.5	29.6	151	253	1,499	1,068	672
41	Fort Worth, Tex	2,338	2,571	2,927	14.3	17.4	152	122	1,230	797	594
42	Fresno, Calif	3,280	3,878	3,863	6.9	22.5	107	132	1,561	1,408	625
43	Gary-Hammond-East Chicago, Ind.	2,674	3,260	3,310	11.1	34.5	194	149	984	904	1,033
44	Grand Rapids, Mich	1,933	1,933	2,188	3.4	18.8	61	136	1,037	700	232
45	Greensboro-Winston-Salem-High Point, N.C.	1,540	1,684	1,987	13.2	12.1	51	355	712	635	208
46	Greenville, S.C	(NA)	2,054	2,602	8.5	14.3	87	116	916	1,049	410
47	Harrisburg, Pa	897	1,028	1,339	2.3	9.0	53	70	617	323	266
48	Hartford, Conn. SEA	1,522	2,218	2,390	2.5	8.8	68	103	1,017	724	468
49	Hartford, Conn. SMSA	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
50	Honolulu, Hawaii	2,526	3,123	3,283	3.6	12.7	42	28	1,457	1,102	637
51	Houston, Tex	2,677	3,022	3,511	16.8	26.6	289	186	1,509	787	697
52	Huntington-Ashland, W. Va.-Ky.-Ohio.	1,162	1,418	1,413	3.8	8.4	37	133	554	511	164
53	Indianapolis, Ind	2,294	2,653	2,798	7.0	23.6	176	101	1,249	636	605
54	Jacksonville, Fla	3,218	3,546	4,035	13.8	41.0	217	372	1,768	1,117	507
55	Jersey City, N.J	1,733	2,273	2,301	8.6	9.5	130	73	726	325	1,029
56	Johnstown, Pa	368	419	458	1.5	3.7	15	20	243	125	49
57	Kansas City, Mo.-Kans	2,666	2,990	3,748	10.8	43.2	255	226	1,494	955	765
58	Knoxville, Tenn	1,476	1,470	1,597	8.8	6.0	32	126	756	380	289
59	Lancaster, Pa	556	623	627	2.0	7.4	25	35	305	178	76
60	Lansing, Mich	2,239	2,570	2,991	1.6	21.9	59	130	1,244	1,203	332
61	Little Rock-North Little Rock, Ark.	2,402	2,761	3,420	15.5	36.6	148	337	1,360	1,272	251

[a]From U.S. Department of Commerce, 1970, Metropolitan Area Statistics, p. 850 and 866.

TABLE B-7 Continued

	SMSA	CRIME RATE PER 100,000 POPULATION [1]									
					Violent crime, 1969				Property crime, 1969		
		Total, 1967	Total, 1968	Total, 1969	Murder and nonnegligent manslaughter	Forcible rape	Robbery	Aggravated assault	Burglary	Larceny, $50 and over	Auto theft
1	Los Angeles-Long Beach, Calif.	4,117	4,705	4,852	9.7	51.8	286	355	1,902	1,386	862
2	Louisville, Ky.-Ind.	2,928	3,323	3,758	12.8	24.4	210	124	1,098	1,333	956
3	Memphis, Tenn.-Ark.	2,286	2,574	2,691	12.6	16.3	158	111	1,237	811	345
4	Miami, Fla.	3,596	4,018	4,460	12.8	17.5	382	409	1,526	1,435	678
5	Milwaukee, Wis.	1,613	1,719	1,929	3.3	7.6	53	60	517	870	420
6	Minneapolis-St. Paul, Minn.	2,566	3,034	3,231	3.2	20.1	165	80	1,206	1,067	689
7	Mobile, Ala.	1,772	2,053	2,433	13.3	18.2	80	162	1,367	534	259
8	Nashville, Tenn.	2,815	2,901	3,185	14.2	25.2	155	256	1,228	867	639
9	New Haven, Conn. SEA	1,829	2,402	2,726	4.1	9.9	50	81	1,104	874	604
10	New Haven, Conn. SMSA	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
11	New Orleans, La.	3,337	3,399	3,467	10.3	39.7	266	283	1,056	1,036	776
12	New York, N.Y.	3,834	4,734	4,732	9.4	19.4	522	267	1,674	1,392	848
13	Newark, N.J.	2,736	3,520	3,261	7.3	19.9	269	170	1,250	865	681
14	Norfolk-Portsmouth, Va.	2,673	3,053	3,160	8.0	22.5	189	226	1,142	1,142	431
15	Oklahoma City, Okla.	1,919	2,300	2,343	8.3	17.3	93	165	1,132	511	417
16	Omaha, Nebr.-Iowa	2,007	2,557	2,663	5.7	12.3	131	202	856	783	673
17	Orlando, Fla.	1,919	2,080	2,560	9.5	22.0	75	187	1,268	776	223
18	Paterson-Clifton-Passaic, N.J.	1,456	1,828	1,922	2.3	5.0	70	49	678	704	414
19	Peoria, Ill.	1,550	1,916	2,125	3.1	14.8	130	155	895	664	263
20	Philadelphia, Pa.-N.J.	1,363	1,569	1,753	7.5	16.1	131	111	701	370	417
21	Phoenix, Ariz.	3,437	3,472	3,962	7.2	27.5	142	277	1,686	1,258	566
22	Pittsburgh, Pa.	1,561	2,106	2,127	3.2	14.8	143	107	768	558	533
23	Portland, Oreg.-Wash.	2,775	3,073	3,627	5.0	23.0	157	144	1,530	1,281	488
24	Providence-Pawtucket-Warwick, R.I. SEA.	2,186	2,760	2,903	3.2	3.8	83	90	987	789	947
25	Providence-Pawtucket-Warwick, R.I.-Mass. SMSA.	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
26	Reading, Pa.	842	888	1,052	2.4	11.8	45	52	484	305	153
27	Richmond, Va.	2,329	2,468	3,183	11.0	23.1	160	138	1,345	903	604
28	Rochester, N.Y.	1,450	1,754	1,820	5.6	9.5	50	105	640	803	208
29	Sacramento, Calif.	2,822	3,438	3,793	4.9	23.4	129	108	1,525	1,469	534
30	St. Louis, Mo.-Ill.	2,304	2,900	3,302	14.3	34.2	248	207	1,360	608	831
31	Salt Lake City, Utah	2,200	2,429	2,977	2.9	20.3	75	87	1,155	1,216	421
32	San Antonio, Tex.	2,489	3,487	3,459	12.1	29.7	111	260	1,479	944	623
33	San Bernardino-Riverside-Ontario, Calif.	2,690	3,069	3,743	4.8	25.7	99	170	1,766	1,266	412
34	San Diego, Calif.	1,929	2,199	2,587	4.2	19.1	85	91	829	1,152	407
35	San Francisco-Oakland, Calif.	3,599	4,666	5,441	9.5	46.1	383	227	2,242	1,362	1,172
36	San Jose, Calif.	2,018	2,467	3,000	2.6	31.6	71	102	1,304	968	521
37	Seattle-Everett, Wash.	2,629	3,328	4,329	5.4	30.1	209	134	1,883	1,432	636
38	Shreveport, La.	1,518	1,755	1,864	18.1	9.1	60	263	743	523	248
39	South Bend, Ind.	1,775	1,770	1,973	2.4	8.0	134	60	734	719	317
40	Spokane, Wash.	1,436	1,841	2,130	2.7	8.4	60	49	916	830	264
41	Springfield-Chicopee-Holyoke, Mass. SEA.	1,255	2,028	2,467	2.3	5.5	32	66	886	684	792
42	Springfield-Chicopee-Holyoke, Mass.-Conn. SMSA.	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
43	Syracuse, N.Y.	1,617	1,902	1,577	2.4	10.0	70	63	681	571	179
44	Tacoma, Wash.	1,832	2,224	2,843	3.3	26.0	113	148	1,225	944	384
45	Tampa-St. Petersburg, Fla.	2,992	3,442	3,247	8.0	22.1	163	248	1,602	901	304
46	Toledo, Ohio-Mich.	1,902	1,776	2,050	3.2	17.7	129	96	787	755	263
47	Trenton, N.J.	2,632	3,076	3,098	8.2	15.7	270	85	1,260	935	525
48	Tucson, Ariz.	2,043	2,502	2,705	5.1	22.9	85	148	1,206	756	483
49	Tulsa, Okla.	2,092	2,584	2,840	5.4	19.8	87	129	986	1,144	468
50	Utica-Rome, N.Y.	619	712	869	4.5	4.5	15	24	463	235	123
51	Washington, D.C.-Md.-Va.	2,840	3,417	4,019	12.5	27.6	524	217	1,496	1,003	739
52	Wichita, Kans.	2,033	2,155	2,532	5.0	13.7	74	123	992	979	345
53	Wilkes-Barre-Hazleton, Pa.	497	601	613	1.5	2.1	12	21	223	256	97
54	Wilmington, Del.-N.J.-Md.	1,875	2,125	2,393	6.8	13.3	129	96	875	737	537
55	Worcester, Mass. SEA.	1,844	2,349	2,874	2.2	6.4	72	57	1,221	619	896
56	Worcester, Mass. SMSA.	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
57	York, Pa.	1,051	899	1,062	3.8	6.3	48	61	529	249	165
58	Youngstown-Warren, Ohio	1,370	1,408	1,698	6.2	7.8	115	108	605	484	372

the increase around the country. Over the last ten years, street robberies have increased 229 percent, pocket pickings 109 percent, purse snatchings 332 percent; these crimes are those most often committed in the area of public transportation systems. Fear of attack thus contributes to decreased use of public transportation. Other transportation-related crimes have also increased in the last decade. Service station robberies increased 230 percent and auto theft 183 percent. Although a complete solution to this insidious problem awaits a fundamental social change, significant improvements can be made by designing transportation systems imaginatively to provide for security.

The inability of a person to move freely to and from his neighborhood no doubt contributes to unemployment, which is a forcing function for social ills. The use of transportation, subsidized if need be, is one of the ways to help overcome it.

An essential step in combating many social ills is to restore mobility to those who don't have it. Better public transportation can help bring this about.

Summary of Problems and Possible Solutions Transportation needs, objectives other than improved transportation, alternative systems or combinations offering promise of meeting objectives are briefly discussed.

In the area of people-technology interaction, the goals and needs, institutional problems, impacts on urban areas, including land use, energy output and use, user preference and freight and goods movement, are described. Some discussion concerning the magnitude of the problem is included.[2,9,10,12,14]

Other areas of concern and what can be done are outlined, including comments on public transportation, private or personal transportation, relieving congestion through system design of road nets, transit and freight movements, parking and traffic control. Suggestions for action are discussed briefly.[11,13,33]

Background Information on Urban Development—Urban Transportation Systems

This committee working paper summarized previous work on urban development and urban transportation alternatives. The National Goals Research Staff report, the HUD report, *Tomorrow's Transportation,* reports by the Mitre Corporation and Johns Hopkins University done for DOT concerning new urban transportation systems were all outlined in brief.[7,19,29]

CONSULTANTS' REPORTS

Federal Transportation Programs for the Urban Poor—Inai Bradfield

The paper examined demonstration projects supported by government after 1965 that were designed to create new employment opportunities for the poor. Several of these projects are described and analyzed. The observation was made that the role transportation alone can play is more limited than expected, even though it is a major catalyst in coordinated social and economic policies for dealing with poverty. Special problems of the poor, old, and handicapped related to transport needs are considered. Additional research through demonstrations involving demand-responsive systems and various types of subsidization is recommended. Such demonstrations must be planned within the overall transport planning and urban planning framework. It cites lessons to be learned from Singapore's slum eradication, satellite community development, and downtown renewal programs and points to the need for overall social and economic reforms, as well as transportation planning, in dealing with the problems.

Estimation of per Capita Auto Ownership—R. M. Michaels

The report examines the methodology of estimating and forecasting auto ownership and notes that while accuracy of auto registration records may be high, there is an uncertainty of $\pm$ 1–2 percent in estimates of the fraction of population owning automobiles that is due to uncertainty in population figures between census years. The report notes that multiple car ownership complicates determination of vehicle-miles driven and thus highway planning. The observation is made that forecasting density of auto ownership involves a ratio of predicted population to predicted auto registration and can introduce errors of some 10–20 percent in a prediction of 10 to 20 years ahead. The limitations of the use of auto ownership for urban planning are noted, with indications of possible errors.

User Preferences for Urban Transportation—R. M. Michaels

The report examines data concerning user preference in representative medium- and large-sized cities for shared or private transportation. The report indicates that the present state of the art in measurement of preferences for transportation is extremely primitive and infers that too much of transport system planning and design has been determined by engineering and economic considerations rather than psychological and social considerations. There has been far too little transfer of knowledge from the social science disciplines. The report concludes that considerable research is necessary and makes specific recommendations aimed at providing the basic knowledge and the development of techniques for measuring user needs and preferences. Additional work is recommended to develop more

reliable methods for quantitative measurement of attitudes and preferences for transportation, improved scaling techniques, better definition of classes of user needs, additional understanding of nonwork trip travel, better understanding of behavioral models, along with development of more practical models.

Urban Goods Movement—E. K. Morlock and P. L. Watson

The report examines data concerning case histories of the attempts of various cities to solve the freight or goods movement and delivery problem and the interrelationship of such distribution systems with passenger system operations. The report considered the current and past methods of improving urban goods movement and concluded that many of these are feasible today within the existing institutional and economic context of urban goods distribution. It indicated that before any new systems of urban goods movement are devised, the necessary fundamental research should be accomplished as a prerequisite. In addition, the report recommends increased effort on short-term demonstrations as well as on long-term research on urban goods movement.

Institutional Practices, Policies, and Effectiveness in Urban Transportation Planning—R. A. Rice

The report examines the data on institutional practices and policies and the resulting effectiveness obtained with various forms of urban transportation in the United States and elsewhere. It supports research and testing that incorporates increased exchange of planning personnel and emphasizes regional transport history. The report discusses the need for cause-and-effect evaluation and the development of a pool of federal transport planners. It encourages demonstration testing of more promising systems concepts and the establishment of criteria to provide guidance to planners in the areas of pollution, energy use, other costs, and investments.

Taxis, Jitneys, and Dial-a-Ride—Daniel Roos, N. H. M. Wilson, and J. H. Hollomon

The report examines and analyzes data concerning the operation of jitney vehicles, taxis, and buses or dial-a-bus, including consideration of the relative economy and effectiveness of such modes. It recommends additional demonstrations of these transportation modes to further the realization of the full potential from these systems. It indicates that the transit industry is resistant to innovation and change, clings to outmoded concepts that are no longer compatible with the changing urban environment, and has done little to use existing technology in innovative ways. The report concludes that the current range of transit choices is arbitrarily and unreasonably restricted by outmoded regulations and unimaginative opera-

tions. An imaginative review of the potential of transit by regulatory and management groups is recommended to stimulate an expanded range of demand-responsive systems that would serve a greater fraction of the urban areas and provide a wider range of choices to the user.

Social Aspects of Urban Transportation—C. H. Schmidt

The report examines the sociological concepts that pertain to urban goals as these relate to the various institutions of which society is composed and to the use of transportation facilities. The report provides detailed abstracts of the major theoretical and empirical literature on urban transportation as well as an extensive bibliography on the subject. It recommends further social research and investigation in this field, concentrating on the identification of diverse user populations and on detailed studies of the psychological and economic bases of the different demands for transportation. Continued research in various substantive fields, such as the journey to work, should search for relationships between these specific patterns of activity and the urban social structure. The report concludes that such knowledge could provide an increasingly firm base for prediction of human behavior within the transportation system.

Estimates of Pollution from Transportation—D. G. Wilson

The report assembles and analyzes data concerning the generation of pollutants from the consumption of vehicle fuels and other materials used in the urban transportation area.

The efforts studied were extended to include direct vehicular pollution as well as pollution from production of steel and other materials used to make vehicles, e.g., cast iron and coal. Table B-8 is a listing of this information and other representative transportation data. The report argues for the further reduction of pollution by automobiles and recommends establishment of a nationwide network of automated inspection stations, with charges to public and private vehicles reflecting the public cost of vehicle use. It further concludes that such user charges for the scarce resources of the roadway would permit market prices to safeguard both our resources and the environment by the most efficient means available.

SELECTED PRESENTATIONS TO THE COMMITTEE

Edmund Bacon

Mr. Bacon believes technology is moving too fast to rely on *ex post facto* research. He believes that the reality of the process of decision making, especially political decision making, may proceed more rapidly than research. He believes that distribution of people in such a way as to facilitate communications is a main issue. Every square inch of the earth's surface

is precious. He sees the possibility of a new acceptance by the nation of "clustering together," and the possibilities of shaping the way people live in a region in the future, i.e., the "new cities" concept. Therefore, he sees the need for a new type of city planner to take on the difficult task. As an extension to urban development, Mr. Bacon views as most likely regional development along lines of a dynamic linear expansion capable of extension, i.e., a central transportation spine along which various transportation modes reinforce each other, with perpendicular extensions to bordering areas. In his view, such developments are happening and will continue to happen. He outlined his concern about lack of cooperation between the bureaucracies responsible for various modes of transportation and about the lack of adequate staffing for urban transportation in the Department, and he urged an even greater degree of cooperation between DOT and HUD. He strongly urged full-scale demonstration in a real situation as the only meaningful approach to obtain valid answers.

Bertram M. Gross

Professor Gross views the interface between transportation and urban development as an unbelievably complicated interface. He discussed the concept of movement of mass over space and time as related to the movement of energy and information over space and time. In his view, the largest impact for reshaping the face of the earth will come from the technologies of information, transportation, and distribution of energy. There is a need to know considerably more about those areas. He discussed an approach to achieve balanced growth, suggesting an effort to find out more of what the nature of growth and change in American society might be. In his view, if we move from a highly industrial society, to the postindustrial state, there will be tremendous changes in the information and communications fields, which implies changes in patterns of transportation. It was his judgment that the United States is rapidly becoming the first country that might be called a "nation city," and that because of the magnitude of these changes, considerable research effort is necessary to get the right answers.

Britton Harris

Professor Harris believes the urban transportation problem should be looked upon in a long-term context. He believes technical deficiencies exist and that solutions must be obtained, but that short-run solutions alone are not apt to solve the basic problems. He views the United States as an automobile-oriented society in which the growth of cities has been influenced by the automobile. He expects the auto to be with us in some form for many years. However, he pointed out that many things were wrong with the automobile system—it does not serve certain large portions of the population, the expansion of capacity in certain situations is extremely

TABLE B-8 National Transportation Data[a]

	1980				1990			
	Present Trend		Reduction in Auto Travel		Present Trend		Reduction in Auto Travel	
	Min.	Max.	25%	50%	Min.	Max.	25%	50%
Auto production, units	9m	11.5m	9.72m	9.21m	10m	13.1m	10.93m	10.27m
Bus production, units	33,000	42,000	45,000	56,200	37,000	46,000	49,800	62,300
Auto Registration	110m	123m	110.7m	104.8m	130m	155m	135.3m	128.2m
Bus Registration	95,000	125,000	132,000	165,000	100,000	150,000	156,000	187,500
Auto miles	880b	1,112b	875b	781b	910b	1,410b	1.042b	927b
Bus miles	3.14b	4.48b	7.62b	11.43b	3.106	5.37b	8.46b	12.69b
Auto fuel, tons	189m	238m	187m	167m	195m	302m	224m	199m
Bus fuel, tons	1.91m	272m	4.63m	6.94m	1.88m	3.26m	5.14m	7.70m
Auto lubricants, tons	0.660m	0.835m	0.656m	0.587m	0.682m	1.06m	0.783m	0.696m
Bus lubricants, tons	4.710	6.720	11.430	17.150	4,650	8,060	12.700	19,000
New lane miles/yr	12,000	40,000	26,000	23,000	8,000	24,000	16,000	14,000
Cement, tons	3.6m	12m	7.8m	6.9m	2.4m	7.2m	4.8m	0.2m
Asphalt, tons	0.865m	2.88m	1.87m	1.66m	0.58m	1.73m	1.15m	1.01m
Highway steel, tons	0.48m	1.60m	1.04m	0.92m	0.32m	0.96m	0.64m	0.56m
Highway fuels, tons	0.51m	1.72m	1.12m	0.99m	0.34m	1.03m	0.69m	0.60m
Cement production: Coal, tons	0.595m	1.98m	1.29m	1.14m	0.317m	0.95m	0.63m	0.55m
Cement production: Particulates, tons	7,200	24,000	15,600	13,800	2,400	7,200	4,800	4,200
Steel for autos, tons	11.93m	15.24m	12.89m	12.21m	13.25m	17.37m	14.49m	13.60m
Steel for buses, tons	0.20m	0.25m	0.27m	0.34m	0.22m	0.28m	0.30m	0.37m
Total steel, tons	12.61m	17.09m	14.20m	13.47m	13.79m	18.61m	15.43m	14.53m
Steel production: Coal, tons	6.56m	8.89m	7.38m	7.00m	6.06m	8.20m	6.80m	6.40m
Steel production: Particulates, tons	0.278m	0.375m	0.313m	0.297m	0.175m	0.236m	0.196m	0.184m

Steel production: Water (fresh), tons	142.5m	193.0m	160.5m	152.2m	135.0m	182.4m	151.2m	142.3m
Total coal, tons	7.15m	10.87m	8.67m	8.14m	6.38m	9.15m	7.43m	6.95m
Coal combustion: SO_2, tons	0.214m	0.326m	0.260m	0.244m	0.147m	0.210m	0.171m	0.160m
Coal combustion: NO_x, tons	0.100m	0.152m	0.121m	0.114m	0.064m	0.091m	0.074m	0.069m
Coal combustion: Particulates, tons	0.153m	0.217m	0.173m	0.163m	0.083m	0.119m	0.097m	0.090m
Total cast iron, tons	2.21m	2.99m	2.48m	2.36m	2.42m	3.26m	2.70m	2154m
Cast iron production: Particulates, tons	0.016m	0.022m	0.018m	0.017m	0.010m	0.013m	0.011m	0.010m
CO from autos, tons	15.8m	20.0m	15.7m	14.1m	11.8m	18.3m	13.6m	12.1m
HC from autos, tons	2.04m	2.59m	2.02m	1.81m	0.50m	0.77m	0.57m	0.51m
NO_x from autos, tons	3.17m	4.02m	3.15m	2.82m	1.09m	1.69m	1.25m	1.12m
Lead from autos, tons	56,600m	71,300	56,000	50,000	24,400	37.700	28,000	24,800
Particulates from autos, tons	0.789m	0.999m	0.784m	0.700m	1.265m	0.830m	0.935m	0.830m
Bus and highway fuel, tons	2.42m	4.44m	5.75m	7.93m	2.22m	4.29m	5.83m	8.30m
Diesel CO, tons	21,780	40,060	51,750	71,400	20,000	38,600	52,500	74,700
Diesel HC, tons	64,200	117.800	152,300	210,000	59,000	114,000	154,700	198,200
Diesel NO_x, tons	80,500	145,000	192,000	264,000	74,000	143,000	194,000	277,000
Diesel particulates, tons	36,500	52,000	88,500	132,900	36,000	62,400	98,200	147,100
Diesel SO_2, tons	14,500	26,600	34,500	47,600	13,300	25,700	35,000	49,800
Total CO, tons	15.82m	20.04m	15.75m	14.17m	11.82m	18.34m	13.65m	12.17m
Total HC, tons	2.104m	2.708m	2.172m	2.020m	0.559m	0.884m	0.725m	0.708m
Total NO_x, tons	3.350m	4.320m	3.469m	3.198m	1.228m	1.924m	11.518m	1.466m
Total particulates, tons	1.279m	1.689m	1.392m	1.323m	1.521m	1.267m	1.342m	1.265m
Total SO_2, tons	0.228m	0.353m	0.294m	0.292m	0.160m	0.236m	0.206m	0.210m
Total Pb, tons	0.057m	0.071m	0.056m	0.050m	0.024m	0.038m	0.028m	0.025m
Total lubricants, tons	0.665m	0.842m	0.667m	0.604m	0.687m	1.068m	0.796m	0.715m

*Data prepared by S. Loebl, Massachusetts Institute of Technology.

difficult, and it has adverse environmental effects. In his view, the nation will have to face a basic decision in urban areas in the next 20 or 25 years as to whether to preserve the automobile system or to invent and superimpose a new technology in which some characteristics of the automobile must be preserved. He further believes that the technology of transportation faces very serious difficulties when transportation is used to move people, and in his view it is more important to think about moving people than goods. He reflected that perhaps a technological approach to supersede the automobile in dense urban areas would be a system that could function in or out of guideway systems, resulting in 2½ modes, with walking the last ½ mode. This system should be automatically able to store its own vehicles where space isn't at a premium, i.e., a dual-mode-type system. He concluded by stating that there is a need to take another look at the relationship between research and decision making.

John F. Kain

Professor Kain views the task of the transportation planner as interpretation of consumer demands and then designing to answer those needs. Information about consumer demands in the case of urban transportation is very poor, primarily because we do not use prices very extensively, so we have inadequate measures of how various kinds of consumers value various kinds of transportation service individually. He believes that there is a great need for additional research and a need to devise ways of measuring benefits. He discussed the planning for the Bay Area Rapid Transit System and the general subject of subsidizing transportation. He views subsidies as a political matter. In discussing long-range (20–30 years) transportation technologies, he indicated that, in his view, dual-mode systems that can provide the convenience, privacy, ubiquity, capacity, and safety of the urban automobile passenger system are what really should be considered.

Melvin M. Webber

The initial transportation task, according to Professor Webber, was to connect all geographies to other geographies. That task is nearly completed, and now there seems to be a new kind of society emerging in America. The new task for this postindustrial era would be to connect people with other people. He emphasized that we have roads everywhere, but a considerable portion of the population cannot use the roads because they lack the vehicle or the skills to operate it. He recommended a search for a system that combines the tracking capabilities of transit and the privacy of an automobile and that permits everyone to have and drive his own vehicle. He recommended the expenditure of considerable sums of money in R&D on a dual-mode personal-transit kind of system and testing of such a system in a suitable metropolitan area.

APPENDIX

C | Acknowledgments

The Committee on Transportation gratefully acknowledges the willingness of the following leaders from government—federal, state, county, and city; from industry; and from the academic community to share with the Committee their extensive knowledge in the various fields of transportation. Biographical information about members of the Committee and about key participants is included at the end of this section.

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