NATIONAL COOPERATIVE
HIGHWAY RESEARCH PROGRAM REPORT

261

Cost-Effectiveness of Transportation Services For Handicapped Persons

Research Report

PORTATION RESEARCH BOARD
RESEARCH COUNCIL

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM REPORT **261**

Cost-Effectiveness of Transportation Services For Handicapped Persons

Research Report

D. P. Middendorf, K. W. Heathington, F. J. Wegmann, M. W. Redford, A. Chatterjee, and T. L. Bell
Transportation Center
The University of Tennessee
Knoxville, Tennessee

RESEARCH SPONSORED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS IN COOPERATION WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST:

SOCIOECONOMICS
(PUBLIC TRANSIT)

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL
WASHINGTON, D.C.

SEPTEMBER 1983

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to its parent organization, the National Academy of Sciences, a private, nonprofit institution, is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the Academy and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the Academy and its Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

NCHRP REPORT 261

Project 8-27 FY'80
ISSN 0077-5614
ISBN 0-309-03602-X
L. C. Catalog Card No. 83-50216

Price: $9.60

NOTICE

The project that is the subject of this report was a part of the National Cooperative Highway Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council, acting in behalf of the National Academy of Sciences. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the National Academy of Sciences, or the program sponsors.

Each report is reviewed and processed according to procedures established and monitored by the Report Review Committee of the National Academy of Sciences. Distribution of the report is approved by the President of the Academy upon satisfactory completion of the review process.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the Federal Government. The Council operates in accordance with general policies determined by the Academy under the authority of its congressional charter of 1863, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

The Transportation Research Board evolved from the 54-year-old Highway Research Board. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society.

Special Notice

The Transportation Research Board, the National Academy of Sciences, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the individual states participating in the National Cooperative Highway Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

FOREWORD

By Staff
Transportation
Research Board

This report will be of interest to planners, analysts, and researchers concerned with finding ways to meet the mobility needs of physically and mentally handicapped persons. Such persons will find the research results adding substantially to the body of knowledge concerning characteristics of the handicapped population and their travel demand, and alternative transportation solutions and their respective cost effectiveness.

Recognizing the mobility problems faced by physically and mentally handicapped people, transportation providers are trying to develop cost-effective ways to meet the transportation needs of these people. There is a need for methods to allow transportation providers to evaluate the cost-effectiveness of the various transportation options available. The costs and benefits of carrying out directives such as the U. S. Department of Transportation's ruling implementing Section 504 of the Rehabilitation Act of 1973 are uncertain. Existing transportation services are sometimes competitive, thereby draining away available public resources.

The results of the research conducted under NCHRP Project 8-27 are contained in this report. Because several related yet distinct topics are covered in the research, the findings are presented in four chapters:

- Chapter Two presents the findings on the characteristics of the handicapped population including the local, regional, and national incidence of transportation handicapped people and important subgroups or market segments of the handicapped population.
- Chapter Three presents the research results on the travel characteristics of handicapped people including current trip-making characteristics, the potential demand or need for additional travel, and factors affecting the amount of and need for travel.
- Chapter Four contains the research findings on alternative transportation solutions including their costs, utilization, and impact on mobility.
- Chapter Five presents the results of the cost-effectiveness of existing transportation services for handicapped persons.

The research findings have been applied in the development of a User's Guide intended for use by medium-to-large-sized transit agency, city government, and MPO planners and analysts directly involved in the planning and design of transportation services for the handicapped. The Guide is described in Chapter Six of this report and is published in a companion document NCHRP Report 262, "Planning Transportation Services for Handicapped Persons—User's Guide."

A useful synthesis of the important findings and conclusions of previous pertinent research evolved from the literature review conducted under NCHRP Project 8-27 and is entitled "Current Practices in Providing Public Transportation Services for the Handicapped." This agency report is available for purchase in microfiche from the Transportation Research Board (TRB) Publications.

CONTENTS

1 SUMMARY

PART I

3 CHAPTER ONE Introduction and Research Approach
- Description of the Problem
- Objectives of the Research
- Research Approach
- Guide to Documentation

7 CHAPTER TWO Findings: Characteristics of the Handicapped Population
- The Problem of Defining the Transportation Handicapped Population
- Size of the Transportation Handicapped Population
- Location Within an Urbanized Area
- Market Segments Within the Transportation Handicapped Population
- Summary

13 CHAPTER THREE Findings: Demand for Transportation
- Current Trip-Making Characteristics
- Latent Travel Demand
- Factors Influencing Travel
- Importance of Transportation Relative to Other Needs
- Summary

31 CHAPTER FOUR Findings: Alternative Transportation Solutions, Their Costs, and Their Effectiveness
- Description of the Alternatives
- Costs of the Alternatives
- Effectiveness of the Alternatives
- Attitudes Toward Alternatives
- Summary

65 CHAPTER FIVE Findings: Cost-Effectiveness Analysis
- Previous Research on Cost-Effectiveness
- Cost-Effectiveness of Existing Transportation Services
- Cost-Effectiveness Sensitivity Analysis
- Comparison of Alternatives
- Summary

87 CHAPTER SIX Interpretation, Appraisal and Application

88 CHAPTER SEVEN Conclusions and Suggested Research
- Conclusions
- Suggested Research

92 REFERENCES

PART II

95 APPENDIX A Survey of Transit and Specialized Transportation Service Providers

100 APPENDIX B Mail Survey of Transportation Handicapped Persons

114 APPENDIX C Transcripts of In-Depth Personal Interviews with Five Handicapped Persons in Knoxville, Tennessee

130 APPENDIX D Latent Travel Demand for Alternative Transportation Solutions by Market Segment

ACKNOWLEDGMENTS

The research reported herein was performed under NCHRP Project 8-27 by The University of Tennessee, Transportation Center. Dr. Kenneth W. Heathington, Associate Vice President for Research, was the principal investigator and Dr. Frederick J. Wegmann, Professor of Civil Engineering, was co-principal investigator. The other authors of this report are Drs. David P. Middendorf, Associate Director; M. Winston Redford, Manager of Financial Services; Arun Chatterjee, Professor of Civil Engineering; and Thomas L. Bell, Assistant Dean for Research, all of the Transportation Center, The University of Tennessee.

The authors owe their thanks to many individuals who contributed materials, ideas, and suggestions for the findings contained in this report. Specifically, the authors want to express their appreciation to Dr. Thomas C. Hood, Acting Chairman of the Department of Sociology, for conducting in-depth interviews of several handicapped people. These interviews provided considerable insight into the nontransportation factors that affect the behavior of the handicapped people. Thanks are also given to Jeff Trombly, a doctoral student in the Department of Civil Engineering, and to Leanne Cox, a graduate student in the Graduate School of Planning and the Department of Civil Engineering, for their work in developing the two surveys which were conducted as a part of the research project. In addition, the authors express their appreciation to the panel members of NCHRP Project 8-27. The many questions and comments which were made on their reviews of quarterly reports and other materials provided valuable input to the project. These comments from the panel represented both the researcher's and the practitioner's points of view.

COST-EFFECTIVENESS OF TRANSPORTATION SERVICES FOR HANDICAPPED PERSONS

SUMMARY

The objectives of National Cooperative Highway Research Program (NCHRP) Project 8-27 were to study the cost-effectiveness of alternative transportation services for handicapped persons and to develop guidelines for state and local planners, transportation providers, and decision-makers on determining the most cost-effective way of meeting the transportation needs of handicapped people.

Transportation handicapped people constitute a small, but highly diverse, segment of the population. Their functional limitations and abilities, frequency of travel, desire for additional travel, economic status, and access to private automobiles vary considerably. Therefore, it is important that planners stratify the transportation handicapped population into distinct market segments so that transportation solutions can be more closely tailored to the needs of each. The most important and useful ways of segmenting the transportation handicapped population are by overall ability to use public transportation, functional disability, and access to private automobiles.

Transportation handicapped people generally travel less than half as much as other people. However, much of this difference in trip-making is because most transportation handicapped persons are unemployed. The transportation-handicapped 16 years of age or older make about one-fourth as many work trips as other individuals in this age group, but they make about 70 percent as many nonwork trips. Although it may be important to narrow and possibly close the 30 percent gap in nonwork travel, this gap, nevertheless, is not as large as commonly believed. Barrier-free transportation, therefore, could have a much greater impact on the mobility of transportation handicapped persons if it enabled a larger number of them to gain employment rather than to enable simply some of them to make a few more nonwork trips. However, it is doubtful that barrier-free transportation services will significantly lower the unemployment rate of transportation handicapped people. Nearly half of all transportation handicapped persons are over 65 years of age, and a lack of transportation is not one of the major reasons why many younger handicapped people are unemployed.

Although the transportation-handicapped do not travel very often, their latent demand for additional travel appears to be surprisingly low. Various measures of latent demand show that it is only a fraction of the current average daily trip rate of transportation handicapped people. Even if a barrier-free transportation service could satisfy the apparent latent demand, the resulting average daily trip rate would still be much lower than that of the general public.

Three general approaches to improving the mobility of handicapped people have been suggested and tried in the past--modification of existing fixed-route bus systems, specialized door-to-door transportation services, and subsidies to individual transportation handicapped people to enable them to use available taxi services at lower fares. The average additional cost of operating a fixed-route bus system that has been made accessible to the handicapped is approximately $2,000 annually per lift-equipped bus. Depending on lift use, the cost per lift user can range from a few dollars to over $50. Specialized transportation services can cost between $8 and $23 per vehicle-hour of service. The cost per trip depends on many factors and can range from $2 to $15. The average cost of subsidizing taxi use can vary from less than $1 to over $7 per trip.

To date, none of the foregoing approaches has had a significant impact on the mobility of large numbers of handicapped people. Accessible fixed-route bus systems, specialized transportation services, and user-side subsidy programs have not been heavily used by most handicapped people. In most cases, a few people have accounted for a large majority of the trips made under each of these alternatives.

The reasons for the low use of existing transportation services for handicapped persons are many. As previously suggested, the latent demand for additional travel appears to be extremely low. There is also the possibility that most existing transportation services, for one reason or another, do not quite meet the needs of many transportation handicapped people. Many of the handicapped have access to private automobiles and prefer not to use lift-equipped buses, special door-to-door services, or taxis. Another factor that must also be considered is the inaccessibility of the rest of the environment. Transportation handicapped people face numerous other barriers to mobility besides a lack of accessible transportation. These barriers are architectural, physical, economic, psychological, and institutional. Until these other man-made and natural obstacles are also removed, there is a limit to what any barrier-free transportation system can do to increase the mobility of transportation handicapped people.

Equipping conventional transit buses with wheelchair lifts does not appear to be a particularly cost-effective way of meeting the transportation needs of large numbers of wheelchair users. Under current lift utilization rates, the

incremental cost of making a bus transit system accessible to wheelchair users and other severely handicapped persons who cannot board regular buses is largely independent of the demand for the lifts. Thus, the cost of a wheelchair passenger trip decreases as the number of bus trips made by wheelchair users increases. In order for the cost per lift user to equal that for a high cost specialized transportation service, an accessible fixed-route bus system would have to average close to 0.56 lift boardings per day per lift-equipped bus. The highest lift utilization rate attained thus far is 0.33 lift boardings per day per lift-equipped bus by Seattle Metro. No other large or medium-sized transit property has come close to Seattle's lift-use rate. Moreover, it is questionable whether Seattle Metro's lift-use rate will increase any further. Between the autumn of 1980 and the summer of 1982, as Seattle Metro increased the number of lift-equipped buses from 163 to 338, the average number of lift boardings per day per lift-equipped bus dropped slightly from 0.33 to 0.31. Only in small urban areas with bus systems having 15 or fewer buses would an accessible fixed-route bus system have a chance of being as cost-effective as a specialized transportation service.

Door-to-door specialized transportation services with either lift-equipped or ramp-equipped vehicles constitute one of the few alternatives that can potentially serve all types of handicapped people for all types of trips. However, the cost-effectiveness of these services varies widely. Many-to-many specialized transportation services (those serving many origins and destinations) tend to have the highest costs per passenger, particularly when they are operated by transit authorities or local governments. Low vehicle productivity and high wage rates account for the high cost per trip. Specialized transportation services can be made more cost-effective by subdividing the service area into zones, by emphasizing subscription service for regularly occurring trips, or by requiring at least two day's notice prior to the trip. Such measures enable service providers to increase the productivity of the vehicles. Some of the most cost-effective specialized transportation services are the many-to-one (many origins to one destination) or many-to-few (many origins to a few destinations) services operated by social service agencies and private, nonprofit organizations. These agencies often use volunteer drivers. In some cases, agency personnel may drive the vehicles as one of their functions. One of the reasons these services are often so cost-effective is because they serve a limited, well-defined group of people and one or a few specific kinds of trips. Thus, the cost-effectiveness of a specialized transportation service will greatly depend on its function. The more general its function, the higher the cost per passenger is likely to be.

If any transportation solution could be singled out as the one likely to be the most cost-effective for many segments of the transportation handicapped population, it would be a taxi-based, user-side subsidy program. Private carriers, such as taxicab companies, can be highly cost-effective and have the capacity to accommodate a large number of additional trips by handicapped people without having to expand their fleets or add additional vehicle-hours of service. Special provisions, however, have to be made in a taxi user-side subsidy program to accommodate the small subgroup of handicapped people who are physically unable to ride in taxicabs. Moreover, this alternative may not be feasible in all situations for reasons having nothing to do with cost. For various reasons, local taxi companies may not be willing to participate in a user-side subsidy program. If the local taxi industry consists of numerous individual owner-operators, it may be difficult to organize them into an effective program. In some urban areas, the notion of subsidizing a handicapped person's use of taxicab services--often regarded as a premium form of public transportation--may be politically unpalatable.

Therefore, it is not possible to recommend a single transportation solution that is clearly the most cost-effective for all handicapped people in all situations. The cost-effectiveness of any alternative can vary widely, depending on local conditions and many other factors. A solution that may work well in one community can easily fail in another. Most likely, some combinations of alternative solutions will be required, each focusing on particular needs of particular market segments. For these reasons, the research conducted under NCHRP Project 8-27 has resulted in the publication of two documents: NCHRP Report 261, "Cost-Effectiveness of Transportation Services for Handicapped Persons--Research Report," and NCHRP Report 262, "Planning Transportation Services for Handicapped Persons--User's Guide." This report (NCHRP Report 261) documents the results of a study of the cost-effectiveness of alternative transportation services for handicapped persons. The companion document (NCHRP Report 262) provides planners and decision-makers with guidelines on how to evaluate alternative transportation services for handicapped persons and to identify the most cost-effective solutions for their communities.

CHAPTER ONE

INTRODUCTION AND RESEARCH APPROACH

DESCRIPTION OF THE PROBLEM

Making public transportation facilities and services accessible to handicapped persons has been one of the more controversial and complex problems confronting transit operators in recent years. Since the late 1960s and early 1970s when the concern over transportation for handicapped people first became prominent, it has been difficult to find a solution totally acceptable to transportation providers, handicapped persons, agencies, and organizations representing the needs and interests of handicapped people, and local, state, and federal governments.

Often, solutions to the problem have been narrowed to a choice between modifying and retrofitting existing public transit vehicles and facilities and providing specialized transportation services exclusively for handicapped people. Many local planners and transit operators have argued that making existing fixed-route transit systems accessible to handicapped people is a costly solution. They have further argued that this solution only improves accessibility for the few handicapped people who are capable of getting to a transit station or bus stop, while specialized transportation services have the potential of increasing the mobility of larger numbers of handicapped people. Some handicapped people and their advocates, however, dislike the "separate but equal" connotation of specialized transportation services. They contend that these services in the past have not provided a level of service comparable to that provided by regular fixed-route transit systems. They also believe that handicapped people should be able to use the same transportation services that the general public uses, a belief that has often been expressed by the concept of "mainstreaming" handicapped people into the normal activities of the general population. Some handicapped people and their advocates view the problem as a matter of civil rights.

These differences of opinion between transit providers and the handicapped population are by no means as distinct as they might seem. There is no consensus on either side about what should be done to enhance the mobility of handicapped people. Some transit operators have opted to make their bus systems accessible. Others have decided to provide specialized transportation services. Still others have contracted with local taxicab operators to provide door-to-door service at a reduced fare. A few have tried combinations of these approaches. Some of the handicapped who have participated in the local transportation planning process have advocated making the existing fixed-route transit systems accessible, others have stated that specialized transportation services would be more suitable for their needs, and still others believe that both solutions are necessary. What the large majority of handicapped people want or need has, unfortunately, not been adequately determined.

Local planners and transit operators have been hampered to some extent in their efforts to resolve the problem of providing transportation that can be used by handicapped people by frequent changes in federal requirements and planning guidelines. At times, federal regulations have been liberal, allowing local planners and transit operators some leeway in finding the most cost-effective solution for their own locality. At other times, however, the federal regulations have imposed certain solutions that some planners and transit operators believed were too costly or ineffective.

The federal regulations in effect during the course of National Cooperative Highway Research Program (NCHRP) Project 8-27 gave recipients of federal financial assistance the responsibility and the flexibility to find and implement the most cost-effective way of meeting the transportation needs of the handicapped people in their communities. These regulations were promulgated by the U.S. Department of Transportation (DOT) on July 20, 1981, pursuant to Section 504 of the Rehabilitation Act of 1973 (1). They were issued as interim final rules replacing the more prescriptive DOT 504 regulations that had gone into effect on July 2, 1979.

The interim DOT 504 regulations required recipients of federal financial assistance under Section 3 and Section 5 of the Urban Mass Transportation Act of 1964, as amended, to certify that they were making special efforts to provide in their service areas transportation that handicapped persons, especially wheelchair users and semiambulatory persons, could use. Projects evolving from these special efforts were to be identified in the urbanized area's annual Transportation Improvement Program (TIP). Current recipients were given 60 days after the effective date of the regulations to submit their initial certification. Grant applications submitted after the effective date either had to include a certification of compliance with the interim DOT 504 regulations or incorporate a prior certification by reference. The Urban Mass Transportation Administrator and the Federal Highway Administrator were required to accept such certification. Recipients who established a pattern of failing to carry out the special efforts requirement were considered to be in noncompliance with the regulations and were liable to have their certification revoked.

Along with the interim DOT 504 regulations, the Urban Mass Transportation Administration (UMTA) provided some guidelines on the types of projects that met the special efforts requirement. Such projects included:

- Installation of wheelchair lifts on full-size buses or the purchase of buses with wheelchair lifts.
- Specially designed transportation services.
- Improvements in the coordination of existing services provided by governmental health and welfare agencies and private nonprofit organizations to meet the needs of elderly and handicapped persons.
- Payment of current operating costs of previously purchased lift-equipped buses.
- Payment of expenses associated with indirect methods of providing transportation, such as subsidies to reduce taxi fares for wheelchair users or trip coupons issued directly to wheelchair users or other handicapped persons.

Projects funded under Section 16(b)(2) of the Urban Mass Transportation Act of 1964, as

amended, were considered to be responsive to the special efforts requirement if they met each of the following four conditions:

- They served wheelchair users and semiambulatory persons.
- They met a critical need identified by the planning process.
- They were not restricted to clients of any particular organization or institution.
- The fares, if any, were comparable to those charged by the regular public transit system for trips of an equivalent length.

Under the 16(b)(2) program, private nonprofit corporations and associations could obtain federal grants and loans to purchase vehicles and other capital equipment for specialized transportation services exclusively for elderly and handicapped people.

UMTA also gave some examples of programs or levels of effort that it considered to be responsive to the special efforts requirement. These included the following:

- A program for wheelchair users and semiambulatory persons involving an average annual expenditure amounting to at least 3.5 percent of the funds apportioned to the urbanized area under Section 5 of the Urban Mass Transportation Act of 1964, as amended.
- A program in which only buses with wheelchair lifts or ramps are purchased until at least half of the buses in the fleet are accessible to wheelchair users.
- A substitute service with an areal coverage and a level of service comparable to that of the local fixed-route transit system.
- Any type of system or program that ensured that every wheelchair user and semiambulatory person would have public transportation for at least 10 round trips each week at a fare comparable to that charged by the local fixed-route transit system for trips of an equivalent length.

UMTA stressed that the foregoing examples were not regulatory standards or minimum requirements, nor were they intended to cover all possible solutions. Thus, local planners and transit operators were given some flexibility in choosing a means of meeting the transportation needs of their local handicapped population.

New DOT 504 regulations are forthcoming. Section 317 of the Surface Transportation Assistance Act (STAA) of 1982 requires the Secretary of Transportation to promulgate final regulations "establishing minimum criteria for the provision of transportation services to handicapped and elderly individuals by recipients of Federal financial assistance under the Urban Mass Transportation Act of 1964, as amended, or under any provision of law referred to in Section 165(b) of the Federal Aid Highway Act of 1973" (2). The regulations must also establish procedures for monitoring compliance with the minimum criteria and for ensuring that elderly and handicapped persons and the organizations and groups that represent them have adequate opportunity to comment on recipients' plans for meeting the criteria. The Secretary of Transportation was given 180 days after enactment of the STAA to promulgate the regulations. The STAA was signed by the President on January 6, 1983. Whether the new regulations will afford transit operators the same flexibility as the interim DOT 504 regulations remains to be seen.

OBJECTIVES OF THE RESEARCH

NCHRP Project 8-27 was established to use the information and analytical techniques, now available, to develop guidelines for local planners, transportation providers, and elected officials that will enable them to determine the most cost-effective way of meeting the transportation needs of handicapped people in their urban or rural communities. The purpose of the project was to provide federal, state, and local decision-makers with information that will help them identify cost-effective solutions to the problem of providing for the transportation needs of handicapped people. State and local officials and local transportation providers need a method for identifying and evaluating alternative ways of transporting people who have difficulty using regular mass transportation services because of physical, mental, or other health condition. Faced with rising deficits and the possibility of reduced federal funding, local transit operators are particularly in need of information to help them accommodate the transportation needs of handicapped people as effectively as possible with the resources available. The objectives of NCHRP Project 8-27 were to provide this needed information and to describe the methods for determining the cost-effectiveness of alternative solutions in a form that is useful for state and local planners, transportation providers, and decision-makers.

The following were the specific objectives or tasks of the research:

- Develop the methods of cost-effectiveness analysis to be used in the study.
- Review the literature on the provision of transportation services for handicapped people.
- Define the characteristics and current travel behavior of the transportation handicapped population.
- Review and describe the characteristics of the major alternative ways of removing the barriers to travel.
- Assess the impact of each alternative on the demand for transportation by trip purpose and market segment.
- Evaluate the impact of each alternative on the mobility of various market segments of the transportation handicapped population.
- Estimate the cost and the effectiveness of each alternative and combinations of the alternatives.
- Refine the methods of cost-effectiveness analysis based on the results of the previous tasks.

The study was concerned with people who cannot use or have difficulty using existing public transportation services because of a physical or mental disability. These people are often referred to as transportation handicapped. The study was not concerned with elderly people or low-income persons who are physically capable of using existing public transportation facilities and services. Many transportation handicapped persons, however, are elderly and have a low income.

The focus of the research was on transportation solutions to the mobility problems of handicapped people. Three transportation alternatives, in particular, were closely studied:

1. Physical and operational modifications to existing fixed-route bus transit systems to make them more accessible to handicapped people.
2. Door-to-door transportation services specially designed and operated for transportation handicapped persons.

3. Subsidies paid directly to handicapped individuals enabling them to use the transportation services offered by taxi operators and other private passenger carriers at reduced fares.

Each of these transportation alternatives has been implemented in a number of varied settings. A considerable amount of experience has been gained with each. Although troublesome gaps still exist in the data, enough information on the costs and effectiveness of these alternatives is available for rigorous analysis.

The study also considered the alternative of training handicapped persons, especially blind people and mentally retarded persons, to use conventional public transportation services. Mobility training is not a new idea. Experience with this concept over the past 20 years has produced some well-designed training procedures. Data on the cost of mobility training programs are generally available. Unfortunately, less is known about what effect these programs have had on the utilization of public transportation by blind or mentally retarded persons. Therefore, a much less detailed cost-effectiveness analysis of this alternative was conducted in this study.

Accessible transportation is only part of the solution to the problem of improving the mobility of transportation handicapped persons. The natural and man-made environment of the transportation system must also be considered. Even with accessible transportation, handicapped persons may still be denied access to various activities and services because of barriers in the natural and man-made environment. The removal of such barriers through curb cuts, sidewalk repair, special pedestrian signals at intersections, and other pedestrian improvements could conceivably enhance the cost-effectiveness of any transportation solution. Determining the cost-effectiveness of individual pedestrian improvements as well as combinations or programs of such improvements is extremely difficult. The costs of these improvements are often affected by local conditions such as climate and topography. Some improvements involve new devices. Although many communities have installed curb cuts and made other minor pedestrian improvements, there is almost no information on what effect these improvements have had on the mobility of handicapped persons. In NCHRP Project 8-27, an attempt was made to determine the importance of environmental improvements relative to alternative transportation solutions. However, no attempt was made to generalize the cost-effectiveness of various pedestrian improvements because of the scarcity of data.

RESEARCH APPROACH

The approach taken in this research relied heavily on existing data on the size of the transportation handicapped population, current and latent travel demand, costs of transportation alternatives, and the impact of these alternatives on mobility. Thus, extensive use was made of the available literature on transportation services for handicapped persons. The information from the literature was supplemented by mail surveys of transportation providers and handicapped persons as well as in-depth interviews with a few handicapped individuals. This primary data collection involved only minor expenditures of project time and resources. The surveys and interviews were undertaken to augment existing data and to gain further insight into some of the transportation problems of handicapped persons. The major sources of information used in this research are briefly described as follows.

Literature on Transportation Handicapped People

Many of the findings presented in this report were derived from the literature. Several hundred articles and reports were reviewed for the following types of information:

- The results of previous analyses of the cost-effectiveness of alternative transportation services for handicapped people.
- Data on the incidence, characteristics, and current travel behavior of handicapped people.
- Factors that affect the travel behavior of handicapped people, including the physical, economic, institutional, and psychological barriers to travel.
- Data on the latent demand for transportation by handicapped people.
- Alternative solutions to the transportation problems of handicapped people.
- Operational experience with alternative transportation services for handicapped people.
- The utilization of these services by handicapped people, including data on the impact that these services have had on the mobility of handicapped people.
- The cost of providing various forms of transportation that can be used by handicapped people.

Survey of Transit Operators

To augment the literature review, questionnaires were sent to transit operators throughout the United States to obtain more information on existing transportation services for handicapped people. The questionnaires covered both accessible fixed-route, fixed-schedule bus services and specialized door-to-door transportation services. A copy of the questionnaire is included in Appendix A. Relevant statistics from this survey were merged with data from the literature and incorporated into a number of tables in this report.

Mail Survey of Handicapped People

Very little information was found in the literature on the factors that handicapped people consider in deciding to make a local trip and how they plan their local travel. Informal interviews with several handicapped people in Knoxville, Tennessee, indicated that the accessibility of public transportation was only one of many considerations and, in fact, was not necessarily a major consideration. This finding has some very important implications concerning the potential effectiveness of any kind of transportation solution to the limited mobility of handicapped people. Additional information on this aspect of the problem was important to obtain for the objectives of this research.

To gather this information, a mail survey of handicapped people throughout the United States was conducted. Ten national organizations, such as Goodwill Industries, the Arthritis Foundation, United Cerebral Palsy, and the Easter Seal Society, were contacted for the names and addresses of local representatives of each organization in each of 22 urbanized areas. A self-administered questionnaire was designed and pretested, and copies were sent to these local contacts. In a cover letter accompanying the questionnaires, each local agency head was asked to select two handicapped clients and

have each of them complete a questionnaire. Approximately 250 questionnaires were mailed, and 168 were completed and returned.

Appendix B contains a copy of the questionnaire used in the mail survey. It also presents some statistics indicating the characteristics of the handicapped people who responded. To keep the cost of the survey low, the survey was not designed to obtain a probability sample, and the results show that the sample of respondents was heavily biased toward wheelchair users. Nevertheless, the findings of the survey were considered to be important to local planners and transit operators because they indicated the relative importance of other factors besides transportation that affect the travel behavior and mobility of handicapped people, particularly wheelchair users. The questionnaire can be used as a model for additional local or national surveys on this aspect of the handicapped person transportation issue.

Personal Interviews with Handicapped People

In-depth personal interviews were conducted with several handicapped people in Knoxville, Tennessee. Along with the mail survey, these interviews provided some interesting insights into the problems handicapped people have when they travel and the things they often have to consider in planning a local trip. The interviews showed that there is a limit to what improved transit systems and specialized transportation services can do to improve the mobility of handicapped people. Transcripts of these interviews can be found in Appendix C.

GUIDE TO DOCUMENTATION

This research report is one of three documents emanating from NCHRP Project 8-27. The other two reports consist of a literature review entitled "Current Practices in Providing Public Transportation Services for the Handicapped" and a planning manual entitled "Planning Transportation Services for Handicapped Persons--User's Guide" (NCHRP Report 262).

The literature review report is a synthesis of some of the more important findings and conclusions of previous research on the problem of transportation for handicapped people. It discusses the size, composition, and spatial distribution of the transportation handicapped population; the transportation needs and problems of handicapped people; the current travel behavior of handicapped people and their desire for additional travel; the transportation solutions to the travel needs and problems of handicapped people; the impact of these solutions on mobility; and the costs of the various solutions. It also contains an annotated bibliography of reports, articles, and other documents dealing with topics relevant to NCHRP Project 8-27. The literature review report will primarily be of interest to researchers. It is available on a loan basis from the NCHRP or for purchase on microfiche from Transportation Research Board (TRB) Publications.

The research findings of NCHRP Project 8-27 are contained in this report. Because several related yet distinct topics were covered in the research, the findings are presented in four chapters:

- Chapter Two presents the findings on the characteristics of the handicapped population including the local, regional, and national incidence of transportation handicapped people and important subgroups or market segments of the handicapped population.
- Chapter Three presents the research results on the travel characteristics of handicapped people including current trip-making characteristics, the potential demand or need for additional travel, and factors affecting the amount of and need for travel.
- Chapter Four contains the research findings on alternative transportation solutions including their costs, utilization, and impact on mobility.
- Chapter Five presents the results of a cost-effectiveness sensitivity analysis as well as data on the cost-effectiveness of existing transportation services for handicapped persons.

Chapter Six discusses the implications of the findings relative to planning for the transportation needs of handicapped people. It also shows the linkage between the research report and the User's Guide, where the results of this research are applied. Chapter Seven summarizes the major conclusions of the research and suggests areas where additional research and better data would be highly beneficial.

Whereas the research report is intended for a broad, general audience including researchers, planners, and transit analysts, the User's Guide is oriented toward those individuals in planning agencies or transit properties directly involved in the planning and design of transportation services for handicapped persons. The User's Guide applies many but not all of the findings in the research report to the problem of determining the most cost-effective way of providing for the transportation needs of handicapped people in a local community. It indicates how to estimate the size and travel characteristics of different transportation handicapped market segments, how to obtain information on existing transportation services for handicapped persons and determine any unmet needs, how to select alternative public transportation services for handicapped persons, how to estimate the demand for or utilization of alternative services, how to determine the unit cost of alternative services, and, finally, how to select the most cost-effective alternative under different situations.

CHAPTER TWO

FINDINGS: CHARACTERISTICS OF THE HANDICAPPED POPULATION

To design and operate cost-effective transportation services for handicapped people, local planners and transit operators need to understand the characteristics of this segment of the population. They should know approximately how many handicapped persons there are in the community; where these people are generally located; their physical capabilities and limitations; their salient social, economic, and demographic characteristics; the modes of transportation available to them; how often they currently travel, the purposes for which they make trips, and the modes of transportation they currently use; and their desire to travel more often and to new places. Lacking such knowledge, planners and transit operators run the risk of devising transportation solutions that do not adequately meet the transportation needs of handicapped people or accommodate their physical and sensory limitations. Important findings concerning the characteristics of handicapped people and their travel behavior are presented in this and the following chapter.

THE PROBLEM OF DEFINING THE TRANSPORTATION HANDICAPPED POPULATION

Not everyone afflicted with a physical or mental disability or health condition can be expected to have difficulty using public transportation services and facilities. Recognition of this fact has led to the use of the term "transportation handicapped person." Section 16(c) of the Urban Mass Transportation Act of 1964, as amended, defines a transportation handicapped person as: "any individual who by reason of illness, injury, age, congenital malfunction, or other permanent or temporary incapacity or disability, is unable without special facilities or special planning or design to utilize mass transportation facilities as effectively as persons who are not so affected." In practice, this definition has been difficult to apply.

The results of the 1977 National Health Interview Survey (NHIS) showed that the transportation handicapped population is a rather small segment of the total population of people who have some type of handicap or disability (3). According to the survey, there were 26 million people living in Standard Metropolitan Statistical Areas (SMSAs) who either had some kind of physical impairment or used a special aid. Only 2.7 million, or about 10 percent of these 26 million people, were unable to use public transportation without help from others. The survey estimated that 4.6 million people were unable to carry on the major activity for their group, where major activity refers to the ability to work, keep house, or engage in school or preschool activities. Only 30 percent of these 4.6 million people, or approximately 1.4 million, could not use public transportation without help from other people. Of the 3.7 million people who use some kind of special aid, only 41 percent, or about 1.5 million, would need some kind of assistance in using public transportation.

Many physically and mentally handicapped people who might have trouble using public transportation do not always perceive themselves as being transportation handicapped. This fact was discovered by the U.S. Bureau of the Census during pretests of possible questions for the 1980 Census of Population and Housing (4). The Census Bureau conducted two experimental surveys--the National Content Test (NCT) and the National Content Test Reinterview (NCTR). In the NCT, questionnaires were mailed to 28,000 households. In the NCTR, personal interviews were conducted in about 2,300 of the households that had completed an NCT questionnaire. Two-thirds of the people interviewed in the NCTR who claimed to have a physical, mental, or other health condition indicated in one of the two surveys that they were limited or prevented from using public transportation, but in the other survey they indicated that they were not transportation handicapped. Surprisingly, even a few wheelchair users reported that they were not limited or prevented from using public transportation. It appears that whether or not a handicapped individual is also transportation handicapped is often a matter of subjective personal judgment.

Despite these problems of identifying transportation handicapped people, transit operators usually cannot avoid having to do so. Transit operators must have some way of determining whether or not a person is eligible to use a specialized transportation service or to ride on the fixed-route buses at a reduced fare.

Some transit operators, particularly those who provide specialized transportation services, have established elaborate criteria for determining the eligibility of prospective handicapped users. For example, to qualify for the Special Citizens Area Transit (SCAT) service in Akron, Ohio, a handicapped person must have a mass transportation handicap. This is defined as "any permanent or temporary incapacity or disability which results in the inability of a person to perform one or more of the following functions necessary for that person to use mass transportation facilities, equipment, and services as effectively as persons not so affected:

- Boarding or alighting from standard transit vehicles.
- Waiting for or standing in moving transit vehicles.
- Reading and/or comprehending informational signs, brochures, schedules, and maps.
- Hearing and/or comprehending verbal information provided by public transportation personnel (5)."

In San Mateo County, California, only persons who can prove that they are "mobility-impaired" are permitted to use the Redi-Wheels service. A mobility-impaired person was defined as someone who cannot drive a car and who is unable to use the regular bus service without significant difficulty. The San Mateo County Transit District, operator of Redi-Wheels, established criteria for determining eligibility for each of 11 categories of physical disability, five categories of developmental disabil-

ity, and one category of mentally disordered disability (5). In each of these examples as well as in many other cases, the criteria for identifying a transportation handicapped person were incorporated into the applications for user identification cards. The applicants for these specialized transportation services or for the reduced fares for fixed-route buses or taxis were then required to obtain a physician's certification that their physical or mental condition met the eligibility requirements.

Many transit operators and other transportation service providers have relied heavily on the professional judgment of physicians to determine the eligibility of individual applicants. In some cases, such as Redi-Wheels, the service providers let the doctor decide whether or not an applicant is physically unable to use regular fixed-route transit service. In other cases, the doctor only has to certify that the applicant has a disabling condition, and the transit operator decides whether or not that person is physically capable of using the regular fixed-route transit system. In the latter situation, certain handicapped persons usually automatically qualify for the specialized transportation service, the reduced bus fare, or the user-side taxi subsidy. For example, persons using wheelchairs, walkers, and crutches were automatically eligible to use The LIFT in Portland, Oregon (6). Get About Transportation, serving four communities in Los Angeles County, California, automatically accepted persons who were blind, deaf, or suffered from crippling arthritis (5).

The need to apply for an identification card and to be certified by a physician places a burden on those handicapped people who might be eligible for a specialized transportation service, a reduced bus fare, or a user-side subsidy for taxi service. To what extent these requirements inhibit transportation handicapped people from registering for a special service or a reduced fare is difficult to determine from the literature. Information about people who had their applications for certification rejected was not found in the literature, nor was any information found about the attitudes of handicapped people toward the need or requirements for certification.

SIZE OF THE TRANSPORTATION HANDICAPPED POPULATION

Because transportation handicapped people are often hard to identify, planners and researchers have had problems in the past trying to estimate the total number of transportation handicapped people in the population. Even more difficult to estimate are the sizes of the various market segments comprising the transportation handicapped population. Much of the early research on the transportation problems of handicapped people relied heavily on secondary data. Researchers had to infer from these data the size of the transportation handicapped population. Because of different assumptions and definitions, early estimates of the number of transportation handicapped people in the United States ranged from 6 million to 13.4 million (7).

Several recent national and local research studies have produced what appear to be more reliable estimates of the incidence of transportation handicapped people. Each of these studies involved a survey of the general population to locate persons who either cannot use or have difficulty using public transportation because of a disability or health condition.

In 1977, UMTA sponsored a national household survey to obtain detailed information on the transportation handicapped population in urban areas of the United States (8). A national probability sample of 15,704 households was randomly selected and screened to locate transportation handicapped individuals. These individuals were then interviewed in their homes.

From this sample, UMTA estimated that 5.0 percent of the people 5 years of age or older in urban places of 2,500 or more people are transportation handicapped. These are people who, because of a specific permanent or temporary physical problem or incapacity, including aging, have more difficulty using public transportation than people who do not have such physical problems. They do not include people who are confined to their homes. Based on the results of the UMTA national survey, there was an estimated total of 7,440,000 transportation handicapped persons 5 years of age or older in the urban population of the United States in 1977.

UMTA found that the incidence of transportation handicapped people varies considerably across the country. The following incidence rates were estimated for each census geographic region:

- North Central region--3.9 percent.
- Pacific region--4.1 percent.
- Northeast region--4.4 percent.
- South Central region--6.1 percent.
- Mountain region--7.1 percent.
- Southeast region--7.6 percent.

Several local surveys have confirmed the low incidence of transportation handicapped people found in the UMTA national survey. In each of these surveys, a random sample of households was screened to identify transportation handicapped people. A telephone survey conducted on a large, randomly selected sample of households in Dayton, Ohio, yielded an incidence rate of 4.3 percent (9). In Oakland, California, 5.2 percent of the noninstitutionalized population were found to be transportation handicapped. When persons living in homes for the aged and dependent were included, the incidence rate rose to 5.9 percent (10). A survey in Portland, Oregon, indicated that 5.75 percent of the population, including persons in institutions, were transportation handicapped (11). The Southeastern Wisconsin Regional Planning Commission estimated that 3.5 percent of the total population in the Milwaukee SMSA, including persons living in institutions, were transportation handicapped (12). The results of a survey in the Washington, D. C., metropolitan area revealed that only 2.7 percent of the noninstitutionalized population were transportation handicapped (13).

The differences in the incidence rates found in these local surveys may be due to differences in the way the households were screened and the way the transportation handicapped people were identified. They may also reflect the regional variations in incidence rates found in the UMTA national survey.

LOCATION WITHIN AN URBANIZED AREA

Until recently, very little was known about the spatial distribution of transportation handicapped people within an urbanized area. Many secondary sources of data contain only national or regional statistics. Other sources only indicate the number of handicapped people in the entire SMSA or urbanized area. Some local planning agencies and transit

authorities have conducted their own special local surveys, but the sample sizes have usually been too small to estimate the number of handicapped people in small areas within the community. As a result, many planners and transit operators have made certain assumptions about the distribution of the local transportation handicapped population. The most commonly made assumption is that transportation handicapped people are distributed uniformly throughout the urbanized area.

Recent evidence from a large-scale telephone survey in Dayton, Ohio, indicates that the foregoing assumption may not be correct (9). The results of the survey showed that the transportation handicapped population of Dayton was not uniformly distributed over the urbanized area. The incidence rate or percentage of people who were transportation handicapped varied from 1.7 percent in one census tract to 13.5 percent in another. However, no predictable pattern in the geographic distribution of the transportation handicapped population of Dayton was found. The correlation between the incidence of elderly people and the incidence of transportation handicapped people in a census tract was only 0.47. Instead of being clustered around the Central Business District (CBD) in the older, more densely developed and populated part of the Dayton urbanized area, the census tracts with the highest incidence rates were widely scattered. These findings from Dayton indicate that, although transportation handicapped people are widely dispersed, there may be some areas within an urbanized area that have significantly higher concentrations of these people. The problem is in identifying those areas.

The 1980 census provides a solution to this problem. Summary Tape File 3A and the PHC80-2 series of printed reports from the 1980 census will contain tabulations of the estimated number of people with a public transportation disability in each census tract. The Census Bureau defines a public transportation disability as any physical, mental, or health condition lasting 6 months or longer that either limits or prevents the use of public transportation. Thus, the census data will not include transportation handicapped people with temporary handicaps or health conditions. Furthermore, the census will not provide any statistics on transportation handicapped persons under 16 years of age. Despite these limitations, the census tract data on public transportation disability from the 1980 census should help local planners identify areas with large numbers of transportation handicapped persons. Unfortunately, these data were not available in time to be analyzed for NCHRP Project 8-27.

MARKET SEGMENTS WITHIN THE TRANSPORTATION HANDICAPPED POPULATION

It does not require much insight to realize that the transportation handicapped population consists of a very diverse group of people. These people differ considerably from one another in the types of disabilities or health problems they have, the severity of their disabilities or health conditions, their physical and sensory capabilities and limitations, and their attitudes toward and their willingness to overcome or somehow accommodate the effects of their physical or health problems. Because of these physical differences, it is logical to expect that transportation handicapped people will have widely different transportation needs and problems. There is not likely to be a single cost-effective transportation solution for all of these problems. Rather, different solutions will have to be developed, each one tailored to the special needs of a distinct group or market segment of transportation handicapped people. The problem is to segment the transportation handicapped population into a manageable number of meaningful groups so that cost-effective solutions to the unique problems of each group can be designed and implemented.

Various ways of stratifying the transportation handicapped population have been developed (14). Some of the approaches that have been taken include classification by medical condition, degree of mobility limitation, type and degree of activity limitation, degree of difficulty using public transportation, special aids usage, functional disability, and combinations of these stratifications. Each of these approaches has its own advantages and limitations. Of them, classification by type of functional disability appears to be the most useful for designing and evaluating alternative transportation solutions.

Segmentation by Functional Disability

Functional disability refers to an individual's ability to walk, go up and down steps, stand, sit down or get up from a seat, reach with hands and arms, lift and carry objects, see, hear, speak, and reason. Each functional disability implies the kinds of problems that a person with that disability might have in using public transit. For example, someone who has trouble using his or her arms and hands may have difficulty grasping a handrail while entering or leaving a bus; holding onto coins, tickets, tokens, or transfers; placing coins, tickets, or tokens into the fare box; grasping stanchions, overhead bars, or seat backs while moving along the aisle of a bus; maintaining his or her balance while the bus is moving; reaching and pulling the signal cord; and pushing open the rear door on a bus.

In the UMTA national survey, the urban transportation handicapped population was stratified into five groups:

1. Persons who use wheelchairs.
2. Persons who use one or more mechanical aids, such as braces, crutches, walkers, canes, or artificial limbs.
3. Persons who have trouble seeing.
4. Persons who have trouble hearing.
5. Persons who have other problems, such as difficulty in going up or down steps, stooping, kneeling, and traveling more than one block.

The following numbers of people were estimated for each of these groups:

- 409,200 people, or 5.5 percent of the transportation handicapped population, use wheelchairs.
- 1,938,600 people, or 26.1 percent of the transportation handicapped population, use one or more mechanical aids or prosthetic devices.
- 1,566,000 people, or 21.0 percent of the transportation handicapped population, have trouble seeing, including 259,100 people, or 3.5 percent of the transportation handicapped population, who are totally blind.
- 1,572,800 people, or 21.1 percent of the transportation handicapped population, have trouble hearing, including 371,700 people, or 5.0 percent of the transportation handicapped population, who are totally deaf.

- 3,502,300 people, or 47.1 percent of the transportation handicapped population, experience other types of problems (8).

The fact that the sum of these percentages equals 120.8 percent shows that many transportation handicapped people have more than one type of disability.

A more detailed breakdown of the transportation handicapped population by functional disability was obtained by the Dayton survey (9). The results are given in Table 1. The frequent occurrence of multiple disabilities is also evident in these figures.

Table 1. Distribution of transportation handicapped population of Dayton, Ohio, by functional disability.

Type of Functional Disability	Percent of Transportation Handicapped Population
Difficulty walking	68.0
• Uses a wheelchair	12.0
• Uses leg braces, crutches, a cane, or a walker	28.7
Difficulty going up and down steps	69.0
Difficulty standing for more than a few minutes	59.7
Difficulty using one or both hands or arms	25.0
Difficulty seeing even with glasses on	26.9
• Totally blind, i.e., unable to see well enough to detect moving objects, such as cars moving or people walking	5.9
Difficulty hearing even with a hearing aid	14.1
• Totally deaf, i.e., unable to hear well enough to detect loud noises	1.9
Difficulty speaking	10.1
Mental disability	8.9
Difficulty getting around outside the home because of a respiratory condition or a heart condition	34.5

SOURCE: Ref. 9.

One of the more noteworthy findings of previous studies is the very low incidence of wheelchair users. The UMTA survey estimated that there were only 409,200 wheelchair users in the noninstitutionalized urban population in 1977 (8). These people constituted only 5.5 percent of the transportation handicapped population and only 0.275 percent of the urban population 5 years of age or older. Only 49 percent of these people used a wheelchair all or most of the time, while the rest used a wheelchair only occasionally. Data from the 1977 NHIS corroborate some of these findings (3). According to the NHIS, there were about 396,000 noninstitutionalized wheelchair users in SMSAs throughout the United States. Interestingly, 18 percent of the wheelchair users interviewed in the NHIS claimed they would not need help in using public transportation. In Dayton, about 12 percent of the transportation handicapped people used a wheelchair (9). This is over twice the percentage found in the UMTA national survey, but still represents a relatively low rate of incidence. These findings are significant because they indicate that much of the controversy over lift-equipped buses and accessible subway systems has centered on the needs of a very small although important segment of the total transportation handicapped population. The transportation problems of wheelchair users are hard to solve economically, and some of the solutions to these problems may benefit only a few people.

Another segment of the transportation handicapped population often singled out for special consideration, particularly in past federal regulations, consists of persons who are semiambulatory. These are people who do not use a wheelchair, but who do have trouble walking or going up and down steps. Both the UMTA national survey and the Dayton survey found that a slight majority of transportation handicapped people belong to this group. UMTA estimated that 51.9 percent of transportation handicapped people have difficulty walking more than one block but do not use a wheelchair. Furthermore, 59.9 percent have difficulty going up or down stairs, although they have no need for a wheelchair (8). In Dayton, 56.0 percent of the transportation handicapped people had difficulty walking and 57.0 percent had difficulty going up and down steps, even though they did not require a wheelchair (9). These people could conceivably benefit from such items on buses as lower front steps, ramps, and kneeling mechanisms. Many existing buses have a kneeling mechanism that lowers the front entrance closer to the ground, but these devices apparently are not deployed very often (15). Semiambulatory people might also be able to use the wheelchair lifts, although some transit operators have adopted a policy of not allowing people to stand on a lift while it is in operation (16).

Combining wheelchair users with semiambulatory people, the UMTA national survey shows that 56.9 percent of the transportation handicapped population have difficulty walking or going more than one block. This fact suggests that the potential effectiveness of an accessible fixed-route bus system could be limited. By their nature, fixed-route bus systems rely heavily on pedestrian access, except near the termini of routes where park-and-ride facilities allow for automobile access. One commonly used rule of thumb in transit route planning is that bus users should not have to walk farther than 1/4 mile to reach a bus stop. For the majority of transportation handicapped people who have difficulty walking or going more than one block, even this short distance can be a major obstacle. Another commonly used assumption in transit demand forecasting is that people will generally not walk more than 1/2 mile to reach a bus stop. The UMTA national survey found that 2,500,000 transportation handicapped people, or nearly one-third of all transportation handicapped people in urban areas, lived more than 1/2 mile away from a fixed-route transit service. About 71 percent of the transportation handicapped people living within 1/2 mile of a fixed-route bus system have difficulty getting to a bus stop (8). All of these findings indicate that, no matter what improvements are made to the buses themselves, a majority of the transportation handicapped population would have difficulty using the service because they would have trouble getting to the bus stop. Thus, the potential effectiveness of an accessible fixed-route bus system appears to be considerably limited.

Three other identifiable and unique market segments within the transportation handicapped population consist of people who are either blind, deaf, or mentally handicapped. The UMTA national survey and the Dayton survey indicate that each of these groups is quite small. Whereas 21.0 percent of the transportation handicapped people nationwide have trouble seeing, only 3.5 percent of all transportation handicapped people in urban areas of the United States are totally blind. In Dayton, 26.9 percent of the transportation handicapped popula-

tion have trouble seeing even with glasses on, but only 5.9 percent cannot even see well enough to detect moving objects. The UMTA survey found that 21.1 percent of transportation handicapped people have trouble hearing, but only 5.0 percent are totally deaf. The Dayton survey estimated that 14.1 percent of transportation handicapped people have difficulty hearing even with a hearing aid, but only 1.9 percent are unable to hear well enough to detect loud noises. The UMTA national survey does not provide any information on the incidence of mentally handicapped people, but the Dayton survey found that 8.9 percent of the transportation handicapped population in that community had a mental disability. These three market segments, therefore, are each about the same size as the population of wheelchair users. The transportation needs and problems of these three groups, however, have often been overlooked.

Segmentation by Ability to Use Public Transportation

Another way of segmenting the transportation handicapped population is by a person's ability to use conventional public transportation services and facilities. This system of classification is not as useful as classification by functional disability, because it does not indicate or imply the types of problems that different transportation handicapped people have using public transportation. However, it does show how many transportation handicapped people can already travel by public transit, although with some difficulty. This information can be useful to local planners and transit operators who are giving serious consideration either to providing a specialized transportation service or to providing user-side subsidies for taxi service. As a matter of local policy, planners and transit operators should consider whether to restrict the eligibility for these options to transportation handicapped persons who cannot use regular transit.

Several studies have found that a large majority of transportation handicapped people can use public transportation, although with some degree of difficulty (8,9,11).

From the national survey data, UMTA estimated that 19 percent of all transportation handicapped people in urban areas cannot use public transportation at all, 30 percent can use public transportation although with a lot more difficulty than people who are not handicapped, and the remaining 51 percent can use public transportation with only a little more difficulty than people who are not handicapped. Table 2 shows how the overall ability to use public transportation varies by type of functional disability. The results of the UMTA national survey also showed that only 21 percent of the transportation handicapped people living in mass transit areas cannot use regular fixed-route bus service at all, while 69 percent can use bus transit although they are prevented from doing so to some extent, and 10 percent are not prevented from using bus transit at all although they still have some problems traveling by bus.

Table 2. Overall ability to use public transportation by type of functional disability.

Specific Dysfunction Group	Ability to Use Public Transportation: Percent Not Able To Use	Percent Able to Use With a Lot of Difficulty	Percent Able to Use With Little Difficulty
Wheelchair	68	21	12
Mechanical aids	28	36	36
Visual	25	31	44
Hearing	21	28	51
Other problems	12	27	60

SOURCE: Ref. 8.

In Dayton, 29.1 percent of the transportation handicapped population would never be able to get to a bus stop no more than two blocks away from their home, 27.1 percent would always need personal assistance to get from their home to a bus stop no more than two blocks away, 24.0 percent would always need some personal assistance to get on and off a bus, and 15.9 percent would never be able to ride a bus without a traveling companion.

In Portland, Oregon, it was estimated that 68.9 percent of the severely transportation handicapped population in that community could not use regular fixed-route bus transit, but only 12.7 percent of the moderately transportation handicapped people would be unable to use the regular bus service. Transportation handicapped persons were regarded as severely handicapped if they indicated that they could not perform any one of eight specific activities associated with travel by bus, or if they indicated that they would have great difficulty performing more than one of these activities. These findings show that the size of the market for specialized transportation services can be greatly reduced if a transit operator should decide to provide service only to those people who cannot use the regular transit system.

Segmentation by Ability to Travel by Taxi

Transportation handicapped people can also be categorized according to their physical ability to use taxicabs. Those transportation handicapped people who cannot ride in a taxi would not benefit from a taxi user-side subsidy program.

In general, transportation handicapped people are more likely to be able to travel by taxi than by fixed-route bus. According to the UMTA national survey, only 7 percent of the transportation handicapped population cannot use taxicabs at all, while 30 percent are not prevented from using taxi services. The remaining 63 percent can use a taxi but are prevented from doing so to some extent, usually because they cannot afford the fare (8). In the Dayton urbanized area, only 3.4 percent of the transportation handicapped people would always have difficulty sitting in a taxicab, while 7.1 percent would sometimes have this problem. The Dayton survey also found that 15.4 percent of transportation handicapped persons would always need personal assistance in getting in and out of a taxi, while 13.8 percent would occasionally need some assistance (9). Table 3 shows how the ability to use taxicabs varies in Portland, Oregon, depending on the severity of the handicap and the type of special aid used (11). Except for wheelchair users, only a small minority of transportation handicapped people are physically unable to utilize taxicab services.

Segmentation by Ability to Drive and Auto Ownership

Another useful way of stratifying the transportation handicapped population is by ability to drive or, alternatively, by auto ownership. As mentioned earlier in this chapter, some transit operators, in determining whether or not an applicant is eligible to use a specialized transportation service or ride

Table 3. Ability of handicapped people in Portland, Oregon, to use taxi service.

Market Segment	Percent Who Can Use Taxis Easily or With Some Difficulty
All transportation handicapped persons	95.4
Moderately transportation handicapped persons	99.5
Severely transportation handicapped persons	91.4
Transportation handicapped persons who do not use a special aid	93.0
Wheelchair users	62.5
Persons who use a walker	91.7
Persons who use crutches	83.3
Persons who use a support cane	96.3

SOURCE: Ref. 11.

the fixed-route buses at a lower fare, consider whether or not the individual is able to drive or owns a car.

Transportation handicapped people are less likely to have a driver's license and are also less likely to own a car when compared with the rest of the population. The UMTA national survey estimated that 41 percent of transportation handicapped persons 16 years of age or older living in mass transit areas are licensed to drive, whereas 78 percent of the nonhandicapped population have driver's licenses. While 87 percent of the nonhandicapped people 16 years of age or older living in mass transit areas own automobiles, only 61 percent of transportation handicapped people have cars. The UMTA survey also revealed that 42 percent of all transportation handicapped people 15 years of age or older have driver's licenses and 68 percent own at least one automobile (8). A large number of transportation handicapped people apparently own cars but are not licensed to drive them.

The surveys conducted in Dayton, Ohio, and Portland, Oregon, yielded similar results. In Dayton, approximately half of the transportation handicapped people were licensed to drive (9). In Portland, 38.4 percent of the moderately transportation handicapped people and 25.3 percent of the severely transportation handicapped people had driver's licenses (11).

A majority of transportation handicapped people usually have access to private automobiles when they need to travel. The UMTA national survey revealed that 63 percent of the urban transportation handicapped population has access to private automobiles as often as needed or most of the time when needed, while only 11 percent of the transportation handicapped people in urban areas never have cars available when needed (8). In Portland, Oregon, 56 percent of the severely transportation handicapped people and 52 percent of the moderately transportation handicapped people either always or usually have cars available, while 19 percent and 23 percent, respectively, never have access to cars when needed (11). In Dayton, 82 percent of the severely transportation handicapped market and 86 percent of the moderately transportation handicapped market usually have autos available.

As will become more apparent in the next chapter, transportation handicapped persons who are licensed to drive, who own cars, or who usually have cars available travel much more frequently than other transportation handicapped persons. Transportation handicapped people in this market segment may be less inclined to use accessible fixed-route transit systems, specialized transportation services, or taxis at a reduced fare.

Other Market Segments

The transportation handicapped population has been stratified by numerous other social and demographic variables--age, sex, income, employment status, level of education, household size, household income, household auto ownership, length of residence in the urbanized area, marital status, and other characteristics. With the exception of perhaps personal income and employment status, none of these descriptors is particularly useful for designing and evaluating alternative transportation services. There may be some utility in stratifying transportation handicapped people by personal income and employment status for purposes of explaining and predicting travel behavior. Otherwise, the above variables are mainly useful in areas of social research.

Table 4 compares some of the social and demographic characteristics of the transportation handicapped population with those of the urban population in general. It indicates that transportation handicapped people:

- Tend to be older.
- Are more likely to be female.
- Are much less likely to be employed.
- Have much less income.
- Have less education.
- Are more likely to live by themselves.

These are findings from the UMTA national survey, but many local studies have confirmed them (9,10, 12,13).

Table 4. Comparison of transportation handicapped population with with the total urban population.

	Percent of Transportation Handicapped People	Percent of People in Total Urban Population
65 years of age or older	47	11
Female	63	52
Black	21	17
Employed	23[a]	64[a]
Household income:		
Under $4,000	34[b]	15[b]
$15,000 or more	16[b]	32[b]
Education:		
Eighth grade or less	41	27
Completed high school	22	27
Live Alone	23	16

[a]Percent of persons 16 to 64 years of age.

[b]Percent of households.

SOURCE: Ref. 8.

SUMMARY

Not everyone with a physical disability or a health condition has trouble using public transportation. The 1977 NHIS revealed that, of the 26 million people in SMSAs who have a physical impairment or use a special aid, only 10.4 percent, or about 2.7 million, cannot use public transportation

without some type of special assistance. Transit operators, therefore, need to separate the transportation handicapped population from the handicapped population in general. The transportation handicapped population consists of people who have difficulty using public transportation because of a physical disability or limitation, including the effects of aging. These people are not always easy to identify. Transit operators have had to establish criteria for determining whether or not a person is transportation handicapped and therefore eligible for a specialized transportation service or for a reduced fare on either the buses or the taxis. Some transit agencies have established more elaborate criteria than others. Many of them require a physician's certification, although some transit agencies will also accept the certification of a social service agency.

It is important for transit planners and operators to recognize that transportation handicapped people differ considerably in their ability to use public transportation. The 1977 national survey of transportation handicapped people sponsored by UMTA revealed that only about one out of every five transportation handicapped persons is unable to use public transit at all. The rest can physically use public transportation services and facilities, although with varying degrees of difficulty. In evaluating alternative transportation services, transit operators may want to separate transportation handicapped people who can use transit from those who cannot. Various relatively inexpensive improvements in the vehicles and the operation of the transit system may greatly benefit many individuals in the first group, while a specialized transportation service may prove to be more cost-effective for people in the latter market segment. As a matter of local policy, a transit operator may decide to restrict the use of a specialized service to only those people who cannot use the regular fixed-route transit system.

Transportation handicapped people constitute a heterogeneous market for public transportation. These people differ from each other considerably in the number and types of functional disabilities they have and in the severity of their disabilities. The problems they have using public transportation will depend on the nature of their physical and sensory limitations. It therefore makes sense to stratify the transportation handicapped population into market segments that are related to distinct functional disabilities such as the inability to walk, climb steps, use hands and arms, see, hear, speak, or reason. In this way, alternative solutions can be linked to specific physical problems or barriers, and the number of people who might benefit or be affected by various solutions can be estimated.

CHAPTER THREE

FINDINGS: DEMAND FOR TRANSPORTATION

Information on how often transportation handicapped people travel, why they travel, and how they travel can be useful for assessing the need for accessible transportation systems as well as for planning and designing such systems. Data on current trip rates, trip purposes, and modal choice have been used to gauge the latent or potential demand for better transportation. They also provide a basis for measuring the effects of new services and improvements in existing services on the mobility of transportation handicapped people and their propensity to travel.

The effectiveness of any solution to the transportation problems of handicapped people will depend on how many barriers to travel the solution is able to eliminate. Much of the previous research has focused on barriers within the public transportation system itself. Other barriers outside the transit system may be just as important to a handicapped person. The results of the special nationwide mail survey of handicapped clients of private nonprofit social service organizations provided some additional insight into the many factors handicapped people consider in deciding whether or not to travel.

The effectiveness of any solution to the transportation problems of handicapped people will also depend on how much more often these people would like to travel. It may be wrong to presume that transportation handicapped people will travel a lot more often if most of their travel barriers are removed. Some information on the latent travel demand or the unmet travel needs of transportation handicapped people is therefore desirable. Although the reliability of this information is debatable, a number of researchers, nevertheless, have attempted to measure latent travel demand. The results of their measurements do provide some preliminary indication of how much of an effect certain alternative transportation services may have on the mobility of transportation handicapped people.

CURRENT TRIP-MAKING CHARACTERISTICS

Frequency of Travel

Transportation handicapped people travel much less frequently than the general public. Data from urban area origin-destination surveys conducted in the 1960s and early 1970s indicate that the average daily trip rates of urban residents range from 1.7 trips per person to 3.3 trips per person (17). According to the 1969-70 Nationwide Personal Transportation Study, the average person over 5 years of age makes 15.5 one-way vehicle trips per week or about 2.2 one-way vehicle trips per day (18). By contrast, transportation handicapped people on the average travel less than half as often as the general public. Table 5 gives some average daily trip rates of transportation handicapped people as determined by the UMTA national survey and several local surveys. Each of these surveys involved a probability sample of transportation handicapped people.

The rate at which transportation handicapped people travel varies by type of disability, age, income, employment status, whether or not the individual is licensed to drive, household auto ownership, and the availability of a private automobile.

Not surprisingly, wheelchair users and other severely transportation handicapped people travel

Table 5. Average daily trip rates of transportation handicapped people.

Location	Trips per Person per Day
United States: urban places of 2,500 or more people	0.96[a]
Dayton, Ohio	0.91
Oakland, California	1.46[b]
Milwaukee SMSA	0.90
Portland, Oregon	0.95

[a]Derived from an average monthly trip rate of 28.8 trips/person.

[b]Derived from an average weekly trip rate of 10.2 trips/person.

SOURCES:

- United States--Ref. 8.
- Dayton--Magnetic tape of Dayton survey data.
- Oakland--Ref. 10.
- Milwaukee--Ref. 12.
- Portland--Ref. 11.

less frequently than those who are only moderately or slightly disabled. The UMTA national survey revealed the following monthly trip rates for five specific dysfunction groups:

- Wheelchair users--21.0 trips per person.
- Users of other mechanical aids--24.3 trips per person.
- Persons with visual impairments--21.9 trips per person.
- Persons with impaired hearing--25.9 trips per person.
- Persons with other problems--32.5 trips per person (8).

The average monthly trip rate for all transportation handicapped people was 28.8 trips per person. In Dayton, Ohio, wheelchair users made 0.69 trips per day, while all other transportation handicapped people made 0.93 trips per day. In Portland, Oregon, persons classified as severely transportation handicapped traveled 0.8 times a day, while persons classified as moderately handicapped traveled 1.2 times a day (11). Likewise, in Oakland, California, severely transportation handicapped persons made only 6.8 trips per week, while moderately transportation handicapped persons made 10.6 trips, and persons only slightly handicapped made 13.0 trips (10).

The older a transportation handicapped person is, the less he or she travels. In the UMTA survey, for example, transportation handicapped persons 65 years of age or older made on the average only 18.5 trips a month, while transportation handicapped persons under 65 years of age made 37.9 trips per month (8). Table 6 shows how the average trip rate of transportation handicapped people in Portland, Oregon, declined as age increased. It indicates that trip-making decreases significantly after age 60, regardless of the severity of the disability. By comparison, able-bodied elderly people in Portland made an average of 1.4 trips per day (11).

Household income also has a significant effect on the frequency of travel. Table 7 indicates that, in Portland, severely transportation handicapped persons with household incomes between $15,000 and $25,000 made more than twice as many trips a day

Table 6. Average daily trip rates of transportation handicapped people in Portland, Oregon, by age group.

Age Group	Trips per Person per Day: Moderately Transportation Handicapped	Trips per Person per Day: Severely Transportation Handicapped
16-20	N.A.	1.3
21-59	1.8	1.2
60-64	1.3	0.8
65+	1.1	0.7

SOURCE: Ref. 11.

Table 7. Average daily trip rates of transportation handicapped people in Portland, Oregon, by household income.

Household Income	Trips per Person per Day: Moderately Transportation Handicapped	Trips per Person per Day: Severely Transportation Handicapped
$0-$5,000	1.0	0.7
$5,000-$10,000	1.4	1.0
$10,000-$15,000	1.6	0.6
$15,000-$25,000	2.7	1.6
$25,000+	2.8	1.1

SOURCE: Ref. 11.

as severely transportation handicapped persons with household incomes below $5,000. Moderately handicapped persons with household incomes above $15,000 traveled about as often as other people in the general urban population (11).

Transportation handicapped persons who are employed travel much more frequently than their unemployed counterparts. In Oakland, transportation handicapped persons employed full time made an average of 16.7 trips a week, slightly more than the average person in the general population. Unemployed transportation handicapped persons, on the other hand, made only 8.7 trips a week, and retired transportation handicapped persons made only 7.6. Work trips accounted for much of this difference between the trip-making of employed and unemployed transportation handicapped persons. The latter tended to make as many nonwork trips a week as the employed transportation handicapped people (10). In Dayton, wheelchair users who worked outside their homes made 0.92 trips per day, while wheelchair users who were either unemployed or worked at home made only 0.68 trips a day. All other transportation handicapped persons employed outside their homes traveled 1.29 times a day, while those who were either unemployed or worked at home traveled only 0.88 times a day.

Two other significant determinants of trip frequency are possession of a driver's license and the availability of an automobile. Transportation handicapped persons who have access to automobiles travel much more often than those who do not. Regardless of the severity of the handicap, transportation handicapped persons in Portland, Oregon, who were licensed to drive traveled nearly twice as often as those who were not licensed. Moderately transportation handicapped persons licensed to drive made an average of 1.9 trips per day compared to 0.8 trips per day for those without driver's licenses. Severely transportation handicapped persons with driver's licenses made an

average of 1.3 trips per day, while those without driver's licenses made an average of only 0.7 trips per day (11). In Oakland, transportation handicapped persons with driver's licenses made 12.3 trips a week, while those who did not possess driver's licenses made 8.1 trips a week (10). Table 8 compares the average daily trip rates of transportation handicapped individuals who usually had automobiles available when needed with those who seldom had access to cars. Again, for both severely and moderately transportation handicapped persons, the availability of automobiles has a significant effect on the amount of travel.

Table 8. Average daily trip rates of transportation handicapped persons by availability of an automobile.

Market Segment	UMTA National Survey	Portland, Oregon	Dayton, Ohio
With auto usually available	1.1	1.2	0.9
o Severely transportation handicapped	0.9	1.0	0.8
o Moderately transportation handicapped	1.4	1.6	1.2
With auto usually not available	0.7	0.7	0.7
o Severely transportation handicapped	0.6	0.6	0.6
o Moderately transportation handicapped	0.9	0.9	0.9

SOURCES:

UMTA National Survey--The average daily trip rates for all transportation handicapped persons by auto availability were taken from Ref. 19. The average daily trip rate for severely transportation handicapped persons with autos usually available was estimated by using the ratio of trips per day by all transportation handicapped persons with autos available in Portland to the trips per day by severely transportation handicapped persons with autos available in Portland. The same methodology was applied to the other three market segments.

Portland--The average daily trip rates were calculated from data presented in Ref. 11.

Dayton--The average daily trip rates for all transportation handicapped persons by auto availability were calculated from a magnetic tape of the Dayton survey data. The average daily trip rates for severely and moderately transportation handicapped persons were obtained using the same methodology applied to the UMTA national survey trip rates.

The above findings indicate that, although transportation handicapped people generally travel less than half as much as the average person in an urban area, the mobility of handicapped people varies widely. The degree of disability, not surprisingly, is a significant factor in determining a transportation handicapped person's trip-making ability. However, employment status and the availability of an automobile appear to be even more important. Even severely handicapped persons travel much more often if they have jobs or if cars are usually available to them. To what extent accessible public transit systems and specialized transportation services will attract handicapped people who do have access to automobiles is a key question for planners and transit operators. As indicated in Chapter Two, this market segment constitutes a significant portion of the transportation handicapped population.

Purposes of Current Travel

Table 9, based on the results of the UMTA national survey, compares the types of trips made by transportation handicapped people with those made by persons who are not transportation handicapped. The analysis was limited to people 16 years of age or older living in mass transit areas.

Table 9 shows that work trips and medical-therapy trips account for much of the difference in the types of trips made by transportation handicapped people and persons who are not transportation handicapped. The latter are much more likely to take work trips because they are also much more likely to be employed. Transportation handicapped people, on the other hand, are much more likely to take medical-therapy trips. Work trips account for nearly 40 percent of the trips made by people who are not transportation handicapped and only about 20 percent of the trips taken by transportation handicapped persons. Medical-therapy trips constitute 12 percent of the trips made by transportation handicapped people, but only 2 percent of the trips made by other people in mass transit areas. Despite these differences in the proportion of trips made for work and medical purposes, Table 9 shows that transportation handicapped people who do make work trips make them at about the same monthly rate as other people who make work trips. Likewise, the monthly trip rate for medical-therapy trips is not much larger for transportation handicapped people than it is for other people who take that type of trip. In general, transportation handicapped people 16 years of age or older living in mass transit areas make 0.18 work trips a day per person, compared to 0.70 for people who are not

Table 9. Types of trips taken by transportation handicapped people as compared to people who are not transportation handicapped, in mass transit areas.

Type of Trip	Percent of People Taking Type of Trip		Percent of Total Trips Taken		Trips per Person per Month[a]	
	Transportation Handicapped[b]	Not Transportation Handicapped[b]	Transportation Handicapped[b]	Not Transportation Handicapped[b]	Transportation Handicapped[b]	Not Transportation Handicapped[b]
Shopping/personal	77	94	36	29	13.2	16.6
Leisure/recreation	68	87	28	23	11.9	14.4
Medical/therapy	70	31	12	2	4.9	3.9
Work	14	55	19	39	37.8	39.1
School	5	15	5	7	26.4	25.1
All types	97	99	100	100	29.1	54.8

[a]The monthly trip rate in each case is based on only those people who take the associated type of trip.

[b]Includes only people 16 years of age or older.

SOURCE: Ref. 8.

transportation handicapped. Transportation handicapped people make 0.76 nonwork trips a day per person, compared to 1.09 for other people. Thus, the difference in the frequency of travel of transportation handicapped people and other people is greater for work trips than for nonwork trips.

Nearly one-fourth of the transportation handicapped people over 15 years of age in mass transit areas do not take trips for shopping and personal business, and almost one-third of them do not take leisure and recreation trips. Nevertheless, these types of trips together account for 64 percent of all trips made by these people. By comparison, 52 percent of the trips taken by people over 15 years old who are not transportation handicapped are made for shopping, personal business, leisure, or recreation. Transportation handicapped persons who do make shopping and personal trips take these kinds of trips at about 80 percent of the monthly rate of other people. The same is true for leisure and recreation trips.

Table 10 shows that the nature of the disability has some effect on the types of trips taken. Wheelchair users, for example, take a higher than average proportion of their trips for recreational and medical purposes and a much lower than average percentage of trips to and from work. Persons in the other specific dysfunction groups do not deviate significantly from the norm, although persons who use mechanical aids and persons with impaired vision tend to make a slightly higher than average percentage of trips for medical visits and a slightly lower than average percentage of trips to and from work.

Two factors that have a significant effect on the frequency of travel--the severity of the disability and the availability of an automobile--appear to have less of an effect on the purposes of travel. Table 11, based on survey data from Portland, Oregon, shows a few differences in the types of trips made by moderately and severely transportation handicapped persons. The latter made a much higher percentage of trips for medical purposes and a correspondingly lower percentage of trips for shopping. Table 12, based on data from a survey in Dayton, Ohio, shows that severely transportation handicapped persons with autos usually available made a higher percentage of trips for medical purposes than did their severely handicapped counterparts who usually did not have access to automobiles. On the other hand, severely handicapped individuals with limited access to cars made a significantly higher percentage of trips for social, recreational, and religious activities. Among the moderately handicapped people, there were few major differences between those with and those without access to automobiles. The latter tended to make a somewhat higher percentage of trips for medical appointments and social, recreational, and religious activities and a lower percentage of trips for shopping and personal business.

Table 11. Types of trips made by moderately and severely transportation handicapped persons in Portland, Oregon.

Type of Trip	Percent of Trips: Moderately Transportation Handicapped Persons	Percent of Trips: Severely Transportation Handicapped Persons
Shopping	36.5	25.5
Recreation/social	29.6	30.1
Personal business	17.5	14.2
Work	8.4	6.0
Medical/dental	3.6	14.9
Church	2.2	8.2
School	2.2	1.1

SOURCE: Ref. 11.

Modal Choice

Transportation handicapped people currently travel primarily by automobile. According to the UMTA survey, transportation handicapped people living in urban areas make about 72 percent of their trips by private automobile (8). In Dayton, Ohio, 84 percent of the trips are made by car, while in Portland, Oregon, the proportion of trips by car is 79 percent (11). Table 13 compares the distributions of trips found in the UMTA, Dayton, and Portland surveys.

Table 10. Types of trips taken by transportation handicapped people in specific dysfunction groups.

Type of Trip	Percent of Trips: All Transportation Handicapped Persons	Wheelchair Users	Other Mechanical Aids Users	Persons with Impaired Vision	Persons with Impaired Hearing	Persons with Other Disabilities
Shopping/personal	34	31	35	38	38	34
Leisure/recreation	28	35	30	29	26	27
Medical/therapy	11	17	14	14	11	10
Work	18	8	15	12	16	20
School	9	9	6	7	9	9

SOURCE: Ref. 8.

Table 12. Types of trips made by moderately and severely transportation handicapped persons in Dayton, Ohio, by auto availability.

Trip Purpose	Percent of Trips			
	Moderately Transportation Handicapped Persons		Severely Transportation Handicapped Persons	
	With Auto Usually Available	With Auto Usually Not Available	With Auto Usually Available	With Auto Usually not Available
Work and school	21.8	18.0	19.9	16.2
Shopping and personal business	40.5	35.8	41.9	40.7
Medical	7.9	13.4	11.0	4.7
Social, recreational, and religious activities	26.6	32.8	25.3	37.2
Other	3.2	0.0	1.9	1.2

SOURCE: Magnetic tape of data from a telephone survey of transportation handicapped persons in Dayton, Ohio, conducted by Peat, Marwick, Mitchell & Co., for the Urban Mass Transportation Administration in 1980.

Not only do transportation handicapped people rely heavily on the automobile for transportation, they are just as likely to make a trip as auto drivers as they are as auto passengers. Table 13 shows that, nationally, slightly more than half of the auto trips taken by transportation handicapped people are made with the transportation handicapped person as the driver. In Dayton, transportation handicapped persons travel much more often as auto drivers than they do as auto passengers. In Portland, transportation handicapped people make about half of their auto trips as drivers and half as passengers.

Table 14 compares the modal choices of transportation handicapped people with those of people who are not transportation handicapped. It shows that transportation handicapped people depend on the automobile almost as much as nonhandicapped people do. The two groups differ considerably, however, in their relative use of automobiles as drivers and passengers. Compared to nonhandicapped people, transportation handicapped individuals are much more likely to travel as auto passengers. Less than one-third of transportation handicapped people have made trips as auto drivers, compared to two-thirds of the people who are not transportation handicapped. On the other hand, over 60 percent of transportation handicapped persons have traveled as auto passengers, compared to less than one-half of the nonhandicapped population. Transportation handicapped persons 16 years of age or older living in mass transit areas make 38 percent of their trips as auto drivers and 33 percent as auto passengers, while persons who are not transportation handicapped make 62 percent of their trips as auto drivers and only 16 percent as auto passengers.

Table 13. Relative use of various modes of transportation by transportation handicapped persons.

Mode of Transportation	Percent of Trips		
	UMTA National Survey	Dayton, Ohio	Portland, Oregon
Automobile	72	84	79
· As driver	38	47	39
· As passenger	34	37	40
Bus	9	5	16
Walking	7	4	--
Taxi	3	1	2
Subway	2	--	--
Special transportation service	1	3	2
Personally owned van	1	--	--
Other	5	4	2

SOURCES:

- UMTA--National Survey--Ref. 8.
- Dayton--Magnetic tape of Dayton survey data.
- Portland--Ref. 11.

Table 14 shows that transportation handicapped people use any given mode less often than people who are not transportation handicapped. For example, auto drivers who are transportation handicapped average less than 40 auto driver trips a month, while those who are not transportation handicapped average over 50. Transportation handicapped persons who travel as auto passengers make about 15 auto passenger trips a month, compared to 22 for people who travel as auto passengers but are not transportation handicapped. Transportation handicapped people use buses for a higher percentage of their trips than do nonhandicapped people, but transportation handicapped bus users make fewer bus trips in a month's time than do their nonhandicapped bus-riding counterparts. The same is true for the taxi and walk modes of transportation. Transportation handicapped people are more likely to be taxi users, but those who do use taxicabs travel by cab less often than nonhandicapped people who use taxis.

Differences in the modal choices of transportation handicapped people depend to some extent on the type of disability and particularly on the need to use a wheelchair. This can be seen from the

results of the UMTA national survey, summarized in Table 15. Wheelchair users, along with people who use mechanical aids, take a significantly higher than average percentage of their trips by automobile. Compared to the other specific dysfunction groups, wheelchair users are much less likely to travel by bus or taxi or to make a nonvehicular trip. On the other hand, they are more likely to use personally owned vans and specialized transportation services. People with impaired vision take a significantly less than average percentage of their trips by automobile and are more likely than any of the other specific dysfunction groups to walk or use a taxi. Most of the transportation handicapped auto drivers belong to the group consisting of persons with "other problems." Table 16 shows that severely transportation handicapped people in Portland take a higher percentage of trips by auto and taxi and a lower percentage by regular bus, compared to moderately transportation handicapped persons.

One of the principal determinants of modal choice is the availability of a private automobile. Table 17, based on data from the UMTA national survey, compares the modal choices of transportation handicapped people who usually have autos available with the choices of those who seldom or never have access to cars. The latter tend to make a much smaller percentage of trips by automobile and a much higher percentage of trips by bus,

Table 14. Modal choices of transportation handicapped people as compared to people who are not transportation handicapped, in mass transit areas.

Mode of Transportation	Percent Who Use Mode		Percent of Trips		Trips per Person per Month[b]	
	Trans. Handicapped[a]	Not Trans. Handicapped[a]	Trans. Handicapped[a]	Not Trans. Handicapped[a]	Trans. Handicapped[a]	Not Trans. Handicapped[a]
Automobile	--	--	71	78	--	--
· As driver[c]	29	67	38	62	37.9	50.9
· As passenger[c]	62	41	33	16	15.2	22.3
Bus	29	25	12	9	12.3	18.5
Walking	16	16	9	5	15.5	45.2
Taxi	14	5	3	1	5.8	7.3
Subway	3	7	2	3	20.3	25.7
Special transportation service	1	--	1	--	19.3	--
Personally owned van	1	1	1	1	20.9	45.8
Other	5	5	1	3	10.1	35.2

[a]Includes only people 16 years of age or older.

[b]The monthly trip rate in each case is based on only those people who use the associated mode.

[c]An unspecified percentage of people travel by automobile both as a driver and a passenger.

SOURCE: Ref. 8.

Table 15. Modal choices of transportation handicapped people in specific dysfunction groups.

Mode of Transportation	Percent of People in Each Group Who Use Mode (Percent of Trips in Each Group by Mode)					
	All Trans. Handicapped	Wheelchair	Mechanical Aids	Impaired Vision	Impaired Hearing	Other Problems
Automobile--as passenger	66 (34)	72 (46)	69 (39)	72 (45)	68 (36)	62 (30)
Automobile--as driver	32 (38)	20 (33)	28 (39)	16 (19)	27 (37)	39 (41)
Bus	22 (9)	6 (3)	17 (9)	25 (12)	20 (8)	24 (10)
Walking	14 (7)	3 (2)	11 (5)	18 (11)	14 (6)	15 (8)
Taxi	13 (3)	9 (2)	14 (3)	22 (7)	15 (4)	11 (2)
Subway	2 (2)	- -	1 (0.3)	0.03 (0.1)	1 (1)	4 (3)
Personally owned van	1 (1)	5 (6)	1 (1)	1 (1)	1 (0.3)	1 (1)
Special transportation service	1 (1)	6 (5)	1 (1)	1 (0.3)	1 (1)	1 (1)
Other	7 (5)	7 (3)	6 (3)	6 (5)	8 (7)	7 (4)

SOURCE: Ref. 8.

taxi, and walking. Table 18 reveals a similar trend in Dayton. However, the effect of auto availability is slightly more pronounced for moderately transportation handicapped persons than for severely handicapped people. Moderately handicapped persons with limited access to automobiles use bus transit for a higher percentage of their trips than do their severely handicapped counterparts. The latter, of course, have considerably more difficulty using bus transit. Because they also seldom have access to private automobiles, they are unable to travel very often.

LATENT TRAVEL DEMAND

Because transportation handicapped people in general travel less than half as much as the general public, it is reasonable to expect that many transportation handicapped people would like to travel more often than they are now able. Determining the magnitude of this latent or unmet need for transportation is one of the more difficult aspects of planning for the transportation needs of handicapped people. Ideally, planners and transit operators would like to have highly detailed and reliable information on latent demand. This would greatly enhance their ability to evaluate the cost-effectiveness of alternative transportation services and to determine how much service is needed. Unfortunately, latent demand is difficult if not impossible to measure reliably. Miller (20) notes that "the concept of latent demand implies the measurement of a difference between some norm of travel behavior and existing travel." Latent demand is the difference between the number of trips transportation handicapped people currently make and the number of trips they would make under a different set of circumstances. Measuring latent demand means determining how transportation handicapped people will react to a situation they may not have faced before.

A number of researchers have attempted to estimate handicapped people's latent demand for transportation. Although the accuracy of the estimates can always be questioned, it is nevertheless useful to review the results. Some interesting and important conclusions can be drawn from them. In the next chapter, these estimates of latent demand will be compared with existing handicapped ridership on alternative transportation services.

Table 16. Modal choices of transportation handicapped people in Portland, Oregon, by severity of handicap.

Mode of Transportation	Percent of Trips by Mode: Moderately Transportation Handicapped	Severely Transportation Handicapped
Automobile	76.3	80.6
· As driver	44.8	33.0
· As passenger	31.5	47.6
Regular bus	22.1	10.5
Social service agency transportation	0.2	3.3
Taxi	0.4	2.9
Other	1.1	2.5

SOURCE: Ref. 11.

Table 17. Modal choices of transportation handicapped people by availability of automobile.

Mode of Transportation	Percent of Trips by Mode: Auto Usually Available	Auto Usually not Available
Automobile	85	26
· As driver	66	2
· As passenger	19	24
Bus	5	33
Subway	1	8
Taxi	2	7
Specialized transportation	1	1
Walking (or use wheelchair)	3	23
Other	4	3

SOURCE: Results of the UMTA National Survey of Transportation Handicapped People as tabulated by the Congressional Budget Office in Ref. 19.

Table 18. Modal choices of severely and moderately transportation handicapped persons in Dayton, Ohio, by auto availability.

Trip Purpose	Percent of Trips by Mode: Severely Transportation Handicapped Persons: Auto Usually Available	Severely Transportation Handicapped Persons: Auto Usually not Available	Moderately Transportation Handicapped Persons: Auto Usually Available	Moderately Transportation Handicapped Persons: Auto Usually not Available
Automobile	88.3	71.0	84.9	61.5
Bus	3.0	8.1	3.9	21.5
Taxi	0.5	4.7	0.1	3.1
Other	8.2	16.2	11.1	13.9

SOURCE: Magnetic tape of Dayton survey data.

Latent Travel Demand as Expressed by Handicapped People

Most estimates of latent travel demand have come from surveys of handicapped people. In these surveys, respondents have been asked about their desire to travel more often. Several approaches have been taken, some more specific than others. Therefore, the results of each study are reviewed separately below.

In their interviews with handicapped people in Chicago, Michaels and Weiler (21) asked respondents how many trips they would have liked to have made during the previous 2 days but could not make because of their physical or sensory limitations. The results are summarized in Table 19.

Table 19. Latent travel demand of transportation handicapped persons in Chicago, by degree of mobility limitation and population density.

Degree of Mobility Limitation by Population Density	Trips per Person per Day[a]			
	Actual	Latent	Total Desired[b]	Latent as a Percent of Actual
Central City:	0.42	0.34	0.76	81.0
Severe	0.40	0.33	0.73	82.5
Moderate	0.44	0.37	0.81	84.1
Little	0.66	0.33	0.99	50.0
High-Density Suburban:	0.46	0.33	0.79	71.7
Severe	0.39	0.34	0.73	87.2
Moderate	0.57	0.30	0.87	52.6
Little	0.81	0.12	0.93	14.8
Low-Density Suburban:	0.68	0.35	1.03	51.5
Severe	0.69	0.74	1.43	107.2
Moderate	0.67	0.23	0.90	34.3
Little	0.84	0.17	1.01	20.2

[a]Converted from trips per person per week.

[b]Number of trips that the transportation handicapped person would have taken if his or her mobility had not been limited.

SOURCE: Ref. 21.

Several interesting conclusions can be drawn from this table. First, with one exception, the latent demand for travel was always less than the current daily rate of travel. This implies that transportation handicapped people are currently making the majority of their desired trips. Secondly, even if all transportation handicapped people were able to make all of their desired trips, their resulting average daily trip rate would still be considerably less than the average for the general public. In Chicago in 1970, the average person made 2.45 trips per day (17). The results of Michaels and Weiler's study also indicate that the latent demand for travel varies by the severity of the handicap, although this seems to depend on the location within the urbanized area. In the central city of Chicago, there were no significant differences between the latent trip rates of severely, moderately, and slightly transportation handicapped people. In the high-density suburban areas of the Chicago region, severely and moderately transportation handicapped persons had about the same magnitude of latent demand, while the latent demand for travel of persons with little limitation in their mobility was considerably less. In the low-density suburbs, the latent demand for travel increased significantly as the severity of the disability increased.

Several studies have found that the desire to travel more often depends on the type of trip or trip purpose. Abt Associates (22) asked transportation handicapped people in Washington, D.C., how many more trips they would take if a low-cost, barrier-free transportation system were available. Their findings, presented in Table 20, show that the latent demand was highest for trips for shopping, social activities, and church. It was lowest for trips for medical appointments and trips to work or school. Abt Associates made similar findings in a survey of transportation handicapped persons in Boston where 67 percent of the respondents desired to make more social and recreational trips, 50 percent desired to make more shopping trips, 16 percent indicated they would make more trips for medical purposes, and only 14 percent would make more work trips (23). In the UMTA national survey, transportation handicapped persons were asked to indicate how many trips a month they would take if an ideal type of transportation that would solve all of their transportation problems were available (8). Again, as Table 21 indicates, the latent demand for shopping, personal business, leisure, and recreation trips was much higher than the latent demand for medical, work, and school trips.

Table 20. Latent travel demand of elderly and handicapped persons in Washington, D.C., by type of trip.

Type of Trip	Additional Trips per Person per Day[a]
Work or school	0.02
Shopping	0.14
Medical	0.06
Social	0.13
Entertainment	0.07
Church	0.11
All types of trips	0.53

[a]Based on the existence of a barrier-free transportation system.

SOURCE: Ref. 22.

Table 21. Latent travel demand of transportation handicapped people in urban areas, by type of trip.

Type of Trip	Trips per Person per Day[a]			Additional Trips Percent of Current Trips
	Current	Additional[b]	Total	
Shopping/personal	0.33	0.04	0.37	12.1
Leisure/recreation	0.27	0.04	0.31	14.8
Medical/therapy	0.11	0.02	0.13	18.2
Work	0.17	0.02	0.19	11.8
School	0.08	0.01	0.09	12.5
All types of trips	0.96	0.13	1.09	13.5

[a]Converted from trips per person per month.

[b]Based on the existence of an ideal transportation system that would solve all of the transportation problems of the transportation handicapped individual.

SOURCE: UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

However, as a percentage of current trips, the latent demand was about the same for each trip purpose, ranging from 11.8 percent of current trips for work travel to 18.2 percent of current trips for medical-related travel.

The latent demand for travel measured by the UMTA national survey is considerably less than that measured by Michaels and Weiler in Chicago or Abt Associates in Washington, D.C., as a quick comparison of Tables 19, 20, and 21 shows. According to the results of the UMTA survey, transportation handicapped persons in general are already taking about 88 percent of the total trips desired. If the desired additional trips were taken, the resulting average daily trip rate of 1.09 trips per person would still be considerably less than the average daily trip rate of 1.83 trips per person for urban residents 5 years of age or older who are not transportation handicapped (8).

Miller (20) took a much different approach to the problem of measuring latent travel demand. In his study, elderly and physically handicapped persons living within a 13-square-mile area on the north side of Chicago were asked how much more often they would like to participate in each of a number of activities. Their responses are summarized in Table 22. Less than a majority of the people interviewed expressed a desire to participate more often in any of the activities. In general, however, there was a much higher demand for more participation in various social, recreational, and shopping activities than in certain personal business, medical, and school activities. These findings agree with the results of other studies cited earlier. On the other hand, slightly more than one-third of the respondents indicated a desire to go to work more often. This suggests that the latent demand for work trips may be higher than has been measured in other surveys. It also suggests that a barrier-free or ideal transportation system may not be sufficient to enable more transportation handicapped people to go to work. The relative importance of transportation as a factor affecting the ability of transportation handicapped people to work and engage in other activities will be discussed in more detail in a later section of this chapter.

Table 22. Latent demand for more participation in various activities by elderly and handicapped persons on the north side of Chicago.

Activity	Percent Wishing to Participate More Often in Activity
Go out to eat	42
Go to movie	40
Visit friends or relatives	38
Go to museum or art gallery	37
Go to zoo	36
Shop for groceries	35
Go to work	35
Go to church, temple, or synagogue	33
Shop for clothes	32
Go to ballgame	32
Go to public meeting, hearing, lecture, or speech	28
Shop in the Loop	26
Visit city or government offices	24
Go to library	23
Go to beach	21
Go to barber or hairdresser	15
Go to school	9
Go to bank	8
Go to doctor or dentist	4

SOURCE: Ref. 20.

The results of the UMTA national survey reveal how the latent demand for transportation varies by type of disability and other personal characteristics (8). These results are summarized in Tables 23, 24, and 25. In general, the nature of the disability does not appear to have a major effect on the desire to travel more often. Persons with mechanical aids, impaired vision, or impaired hearing appear to have a higher latent demand for travel than wheelchair users and transportation handicapped persons with other types of disabilities. The differences, however, are not large, particularly in view of the fact that nearly 70 percent of the transportation handicapped population indicated that they would not make any additional trips even if an ideal mode of transportation were available. Table 24 indicates that age and level of education have relatively little effect on the desire to make more trips. The effect of household income, however, is more noticeable. Transportation handicapped persons with household incomes below $10,000 have a greater desire to travel more often than do transportation handicapped people with household incomes above $10,000. The latent demand for more travel decreases considerably as the household income rises above $8,000. Likewise, the effect of auto ownership, possession of a driver's license, and auto availability for passenger use on latent travel demand is rather pronounced. Table 25 shows that transportation handicapped persons who do not own cars, who are not licensed to drive, or who do not always have cars available when needed have a much greater desire to make more trips. In each case, however, those transportation handicapped persons who would make additional trips if an ideal transportation system were available constitute less than a majority of the transportation handicapped population.

In the UMTA survey (8), transportation handicapped persons were also asked about the number of additional trips they would take if specific transportation alternatives were provided. Four alternatives were presented to the respondents for their consideration:

1. An accessible fixed-route transit system.
2. An accessible fixed-route transit system served by an accessible feeder system.
3. A specialized, fully accessible, door-to-door transportation system.
4. Individual subsidies to transportation handicapped people to enable them to pay for better transportation.

Table 23. Effect of type of disability on the desire to travel more often.

Specific Dysfunction Group	Percent of Group Who Would Take More Trips[a]
Wheelchair users	27
Mechanical aids users	31
Persons with impaired vision	32
Persons with impaired hearing	32
Persons with other problems	25
All transportation handicapped people	29

[a]Based on the existence of an ideal transportation system that would solve all the transportation problems of the transportation handicapped person.

SOURCE: Data from the UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

Table 24. Effect of age, education, and household income on the desire to travel more often.

Market Segment	Percent of Group Who Would Take More Trips[a]
Age:	
Under 65 years of age	31
65 years of age or older	28
Education:	
Eighth grade or less	29
Some high school	29
Completed high school	29
Some college	29
Completed college or more	34
Household Income:	
Under $4,000	32
$4,000 to $5,999	31
$6,000 to $7,999	35
$8,000 to $9,999	33
$10,000 to $14,999	27
$15,000 to $24,999	20
$25,000 and over	15

[a]Based on the existence of an ideal transportation system that would solve all the transportation problems of the transportation handicapped individual.

SOURCE: Data from the UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

Table 25. Effect of auto availability on the desire to travel more often.

Market Segment	Percent of Group Who Would Take More Trips[a]
Car ownership:	
Own one or more cars	26
Do not own a car	35
Licensed to drive:	
Licensed	24
Not licensed	33
Availability of car for passenger use:	
As often as needed or most of the time	23
Part of the time or occasionally	42
Never when needed	35

[a]Based on the existence of an ideal transportation system that would solve all the transportation problems of the transportation handicapped person.

SOURCE: Data from the UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

Two estimates of latent demand were made for each alternative. The first was based on the maximum conceivable potential number of users. This was simply the number of transportation handicapped persons who indicated they would use an alternative if it were available. The second estimate was based on the barrier sensitive potential number of users. This estimate excluded transportation handicapped persons who said they would use an alternative but who would actually not be able to do so because the alternative would not eliminate all of their reported barriers to travel. The resulting estimates of latent demand are given in Table 26 for mass transit areas and in Table 27 for all urban areas over 2,500 population. Also included in the tables for

Table 26. Latent travel demand of transportation handicapped people in mass transit areas by alternative transportation solution.

Alternative Transportation Solution	Additional Trips per Person per Day[a]		Additional Trips as a Percent of Current Trips[b]	
	Maximum Conceivable Estimate	Barrier Sensitive Estimate	Maximum Conceivable Estimate	Barrier Sensitive Estimate
Accessible fixed-route transit system	0.065	0.031	6.8	3.2
Accessible fixed-route transit system served by an accessible feeder system	0.103	0.046	10.7	4.8
Specialized door-to-door transportation system	0.112	0.073	11.7	7.6
Individual subsidies to pay for better transportation[c]	0.104	--	10.8	--
Ideal transportation system[d]	0.132	--	13.8	--

[a]Converted from trips per person per month.

[b]Current average daily trip rate of transportation handicapped people in mass transit areas = 0.96 trips per person.

[c]Because this solution does not relate to a specific public transportation system, there are no barriers directly associated with this alternative. Therefore, no barrier sensitive estimate of latent demand was made.

[d]An unspecified, hypothetical means of transportation that would solve all of the transportation problems of the transportation handicapped individual.

SOURCE: Results of the UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

Table 27. Latent travel demand of transportation handicapped people in urban areas by alternative transportation solution.

Alternative Transportation Solution	Additional Trips per Person per Day[a]		Additional Trips as a Percent of Current Trips[b]	
	Maximum Conceivable Estimate	Barrier Sensitive Estimate	Maximum Conceivable Estimate	Barrier Sensitive Estimate
Accessible fixed-route transit system	0.043	0.021	4.5	2.2
Accessible fixed-route transit system served by an accessible feeder system	0.069	0.030	7.2	3.1
Specialized door-to-door transportation system	0.101	0.066	10.5	6.9
Individual subsidies to pay for better transportation[c]	0.100	--	10.4	--
Ideal transportation system[d]	0.132	--	13.8	--

[a]Converted from trips per person per month.

[b]Current average daily trip rate of transportation handicapped people in urban areas = 0.96 trips per person.

[c]Because this solution does not relate to a specific public transportation system, there are no barriers directly associated with this alternative. Therefore, no barrier sensitive estimate of latent demand was made.

[d]An unspecified, hypothetical means of transportation that would solve all of the transportation problems of the transportation handicapped individual.

SOURCE: Results of the UMTA National Survey of Transportation Handicapped People reported in Ref. 8.

comparative purposes is the estimated latent demand based on the existence of a hypothetical ideal transportation system that would solve all of the transportation problems of a transportation handicapped individual.

In each case, the barrier sensitive estimate was considerably less than the maximum conceivable estimate, the former ranging between 43 percent and 65 percent of the latter for all urban areas. This demonstrates the problem of noncommitment bias inherent in the responses of people who are asked to estimate how much they would use a new product or service or how they would change their consumer behavior in response to a new set of circumstances. What people say they will do and what they actually do are seldom the same. In this case, it is a matter of what people say they will do and what they actually can do. Many of the transportation handicapped persons interviewed in the UMTA national survey would be physically unable to use a specific transportation alternative even though they indicated that they would make additional trips if the alternative were available.

The results of the analysis presented in Tables 26 and 27 indicate the potential effectiveness of the four transportation alternatives that were considered. The accessible fixed-route transit system alternative is the least effective, primarily because it does not solve the critical problem of getting to and from the system. The provision of an accessible feeder system overcomes this problem to some extent but not as effectively as a specialized door-to-door transportation system. The reason for this is that a large number of transportation handicapped people live in areas not served by a fixed-route transit system. When only mass transit areas are included in the analysis, the potential effectiveness of the two accessible fixed-route transit system alternatives, as implied by the estimates of latent demand, is higher.

Each of the maximum conceivable estimates of latent demand for the four transportation alternatives is less than the latent demand based on the existence of a hypothetical ideal means of transportation. It could be argued that the latter is not a true estimate of the total latent demand for travel. However, under the assumption that it is valid, the accessible fixed-route transit system alternative without the accessible feeder system would only satisfy about one-sixth of the total latent demand. The specialized, door-to-door transportation system, which appears to be the most effective of the four alternatives, would only capture about one-half of the total latent demand. Each of these comparisons was made using the respective barrier sensitive estimates of latent demand for all urban areas. In mass transit areas, the accessible fixed-route transit system alternative would capture about 23 percent of the total latent demand.

Table 28, based on data from the UMTA national survey, shows how the latent demand for alternative transportation solutions varies by market segment. The availability of an automobile has a much greater effect than the degree of disability. Handicapped persons with little or no access to automobiles would make about seven times as many additional trips as would handicapped persons who usually have cars available when needed. On the other hand, the latent demand of moderately transportation handicapped persons is only slightly higher than the latent demand of severely transportation handicapped persons.

Latent Demand Estimates from Mathematical Models

As the preceding discussion pointed out, estimating latent travel demand by asking transportation handicapped people how much more often they would like to travel entails a considerable amount of subjectivity. The resulting estimates are no more reliable than the perceptions or judgments of the people responding. The presence of a noncommitment bias is the main problem. At least one attempt has been made to remove this problem by developing estimates of latent travel demand from mathematical models of the travel behavior of transportation handicapped people.

Table 28. Latent travel demand for alternative transportation solutions by market segment.

Alternative Transportation Solution	Additional Trips per Person per Day[a]			
	Severely Transportation Handicapped Persons		Moderately Transportation Handicapped Persons	
	Auto Usually Available	Auto Usually not Available	Auto Usually Available	Auto Usually not Available
Accessible fixed-route transit system	0.006	0.042	0.008	0.054
Specialized door-to-door transportation system	0.013	0.090	0.017	0.115
Individual subsidies to pay for better transportation	0.020	0.136	0.025	0.174
Ideal transportation service[b]	0.026	0.180	0.033	0.230

[a]Converted from trips per person per month.

[b]An unspecified, hypothetical means of transportation that would solve all of the transportation problems of the transportation handicapped individual.

SOURCE: Derived from results of the UMTA National Survey of Transportation Handicapped People reported in Ref. 8 and Ref. 19. See Appendix D.

Hartgen, Weiss, and Knighton of the New York State Department of Transportation (NYSDOT) developed an empirical method for determining how many additional nonwork trips transportation handicapped people would make if certain travel barriers were removed (24,25). They calibrated their mathematical model with data from a survey of elderly and handicapped people in the Albany, New York, SMSA. The survey collected data on the current frequency of travel, the types of barriers that elderly and handicapped people encounter or would encounter in using transit, the degree of difficulty posed by these barriers, and the number of additional trips these people would take if certain individual barriers were removed. An index of barrier severity was defined equal to the average perceived severity of a given barrier times the percentage of people who encountered the barrier. The researchers developed linear relationships between expected changes in nonwork trip-making and the magnitude of the reduction in the cumulative barrier index associated with the removal of one or more specific barriers. One relationship was developed for the removal of barriers in existing fixed-route bus systems and another for the provision of specialized door-to-door transportation services. Furthermore, in developing these mathematical relationships, Hartgen, Weiss, and Knighton were able to quantify and remove the noncommitment bias contained in the responses of the people who were interviewed. The models were used to predict the increase in nonwork trip-making of transportation handicapped persons resulting from various courses of action to remove one or more transit barriers. The resulting estimates of additional travel are summarized in Table 29.

Table 29. Effect of various barrier removal strategies on nonwork travel of transportation handicapped people.

Barrier Removal Strategy	Additional Nonwork Trips per Person per Day	Additional Trips as a Percent of Current Nonwork Trips[a]
Modifications to existing fixed-route bus systems:		
1. Kneeling mechanism and lift	0.068	8.8
2. Reserved seating	0.054	7.0
3. Shelters	0.051	6.6
4. Extra handrails	0.045	5.8
5. Wheelchair space, ties, etc.	0.025	3.2
6. Leave by front entrance	0.020	2.6
7. Lower signal cords	0.016	2.1
8. Reupholster seats	0.016	2.1
9. Credit card system	0.016	2.1
10. Reduced fares	0.006	0.8
All of the above strategies	0.316	40.8
Specialized door-to-door transportation system:		
1. Basic system	0.305	39.4
2. Lift and kneeling mechanism	0.068	8.8
3. Extra handrails	0.045	5.8
4. Wheelchair ties, etc.	0.025	3.2
5. Reupholster seats	0.016	2.1
6. Credit card system	0.016	2.1
7. Reduced fares	0.006	0.8
All of the above strategies	0.509	65.8

[a]The current daily nonwork trip rate of transportation handicapped people was estimated to be 0.774 trips per person per day.

SOURCE: Ref. 25.

Individually, the various modifications to an existing fixed-route bus system would have little effect on nonwork travel. Collectively, however, their impact would be quite significant. If all of the modifications were made, daily nonwork travel would possibly increase by 41 percent over the current rate of travel. This is a much greater increase than that estimated from the UMTA national survey data.

A basic door-to-door transportation system, such as a taxicab service, would have about the same effect on nonwork travel as a fully modified fixed-route bus system. By adding wheelchair lifts and implementing other barrier removal strategies, nonwork trip-making could increase by an additional 26 percent to about 66 percent of the current rate of nonwork travel. Altogether, a fully accessible, door-to-door transportation system could conceivably increase the number of nonwork trips made by transportation handicapped people by nearly two-thirds. This is also a much greater change than that suggested by data from the UMTA national survey.

Latent Demand Estimates Through Gap Analysis

Another method for estimating the latent travel demand of transportation handicapped people has been suggested. Known as gap analysis, it involves comparing the trip rates of two groups of people who are alike in all respects except level of mobility. Yukubousky and Politano (26), for example, used this approach to estimate the latent travel demand of elderly, young, and low-income people in New York. Within each of these groups, they compared the trip rates of auto-owning households with the trip rates of autoless households. The difference or gap in the trip rates in each case was assumed to be indicative of the latent demand. Falcocchio (27) employed the gap analysis technique to estimate the latent travel demand of disadvantaged urban residents. He cross-classified disadvantaged urban people by age, income, and whether or not they were physically handicapped. Within each grouping, he compared the trip rates of drivers and nondrivers. The difference between the trip rates was defined as the maximum potential latent travel demand rate for the group. By comparing the trip rates of transportation handicapped people who usually have cars available with the trip rates of those who usually do not, an estimate of latent travel demand of tranportation handicapped people could be obtained.

The gap analysis technique described above was applied to current travel data from Portland, Oregon, and Madison, Wisconsin (11,28). In both cases, the transportation handicapped population was segmented into two groups--those who were severely transportation handicapped and those who were only moderately transportation handicapped. Each of these market segments was further stratified by four levels of auto availability--auto always available, auto usually available, auto sometimes available, and auto never available. Two estimates of latent travel demand were made for each market segment. The maximum potential estimate was based on the assumption that better transportation would raise the average trip rates of transportation handicapped people to the current level of travel of transportation handicapped persons who always have cars available. For the conservative estimate, the average trip rate of transportation handicapped people at a given level of auto availability was assumed to increase to the current average trip rate of transportation handicapped people at the next highest level of auto availability. For both types of estimates, the assumption was made that transportation handicapped persons who always have autos available have no latent travel demand. A weighted average estimate of the increase in travel was then obtained for each market segment. The results are given in Table 30.

Table 30. Latent travel demand of transportation handicapped people in Portland, Oregon, and Madison, Wisconsin, estimated through gap analysis.

Market Segment	Current Trips per Person per Day	New Trips per Person per Day		New Trips as a Percent of Current Trips	
		Maximum Potential Estimate	Conservative Estimate	Maximum Potential Estimate	Conservative Estimate
Moderately handicapped					
Portland	1.23[a]	0.67	0.13	54.5	10.6
Madison	2.23[b]	0.37	0.27	16.6	12.1
Severely handicapped					
Portland	0.81[a]	0.29	0.14	35.8	17.3
Madison	1.08[b]	0.32	0.19	29.6	17.6

[a]The current daily trip rates for Portland do not include walk trips.

[b]The current daily trip rates for Madison include walk trips.

SOURCE: Derived from data reported in Ref. 11 (Portland) and Ref. 28 (Madison).

The estimates of latent travel demand derived by the gap analysis technique for Portland and Madison fall within the range of estimates obtained by previous surveys of transportation handicapped people. The maximum potential estimates are close to the latent trip rates measured by Michaels and Weiler in Chicago, while the conservative estimates are close to the rates measured in the UMTA national survey for an ideal transportation system. The estimates of latent travel demand for the severely transportation handicapped market segment are nearly the same for the two cities. The estimates for the moderately transportation handicapped groups, however, differ considerably. The current trip rates of this market segment in the two cities are also quite different, even when taking into account the fact that the trip rate in Madison includes walk trips. This suggests that the moderately transportation handicapped market segments were not the same in the two studies. In general, however, the results of this gap analysis confirm previous findings that the latent travel demand of transportation handicapped people is only a small fraction of the current rate of travel of these people.

FACTORS INFLUENCING TRAVEL

Barriers to Mobility

Much has been written about the kinds of barriers transportation handicapped people face in attempting to use existing public transportation services and facilities. The available evidence on latent travel demand, however, suggests that, even if all of these barriers were eliminated, transportation handicapped people would increase their local trip-making by a small fraction of their current rate of travel. If their need or desire for additional travel could be met, their daily trip rates would still be considerably below that of the general public. This suggests that there are other factors besides inaccessible public transportation that are preventing transportation handicapped people from engaging in more activities outside the home. It is important for transportation planners and transit operators to be aware of these factors and how they affect travel behavior. These factors may place a severe limit on the effectiveness of any transportation solution to the mobility problems of handicapped people. On the other hand, the effectiveness of any transportation solution might be enhanced by removing some of the barriers to travel that exist outside of the transportation system.

There are many possible barriers to mobility. Some of the more common natural and man-made obstacles include steps and curbs, doors, hilly terrain, uneven sidewalks, sidewalk furniture, busy intersections, snow and ice, and inclement weather. Therefore, not only the transportation system, but much of the rest of the physical environment must also become accessible before more transportation handicapped people will be able to increase their mobility. There are also the physical and sensory limitations of handicapped individuals that may preclude independent engagement in certain activities. For example, wheelchair users and blind people might have considerable difficulty shopping for groceries by themselves, even if they were able to travel to and enter a grocery store. Wheelchair users would have difficulty reaching some of the shelves, and blind people would have trouble distinguishing between certain items such as canned goods. Beyond these architectural and physical impediments to travel, there are a number of economic, psychological, and institutional barriers. It has already been shown that transportation handicapped people tend to belong to low-income households. A majority of them are unemployed and may have little income of their own. Thus, many transportation handicapped people may limit their travel simply because they cannot afford to shop more often or participate in other activities. Some transportation handicapped people may travel infrequently for psychological reasons. For example, they may feel embarrassed by their handicap, they may be afraid of becoming lost, or they may feel espe-

cially vulnerable to physical assault or injury. A lack of training or limited education could also either prevent or inhibit some transportation handicapped people from working or engaging in other activities and, consequently, limit their mobility.

A complete list of all possible barriers to mobility, especially those external to public transportation systems, has probably never been compiled. More importantly, there appears to be very little information on the relative importance of these barriers or the number of transportation handicapped people who encounter them. For this reason, a special nationwide mail survey of transportation handicapped clients of private nonprofit social service organizations was undertaken as part of NCHRP Project 8-27. One of the objectives of this survey was to determine the relative importance of various factors that transportation handicapped people might have to consider in planning a local trip. The respondents were given a list of 17 items and were asked to indicate on a scale how much of a concern each item was to them in planning a local trip to a new destination. The results are summarized in Table 31.

None of the 17 items was a major concern to a majority of the respondents in the survey. On the other hand, 11 of the items were a major consideration of over one-fourth of the respondents. Transportation was high on the list of importance relative to the other possible concerns. The respondents were almost as concerned about getting transportation for their return trips as they were about having transportation to their destinations. More than a third of the respondents gave special consideration to curbs, the possible absence of sidewalks, hills, and being able to enter buildings at their destinations. The possibility of being robbed or physically assaulted was also a major concern of over one-third of the respondents. Only a fourth of the people in the sample gave much consideration to the cost of a local trip. Crowded sidewalks and the weather were relatively minor concerns, while embarrassment over one's disability was clearly not a major problem for most of the people in the sample.

Table 32 indicates that wheelchair users have many more major concerns over making a local trip than do all of the other transportation handicapped people surveyed. Although getting transportation to their destinations is a major consideration for a majority of wheelchair users, they tend to be even

Table 31. Concerns of transportation handicapped people in planning a trip.

Travel Concerns	Average Degree of Concern[a]	Percent of People Having a Major Concern[b]
Getting transportation to the destination	3.11	42.8
Getting around a place that has no sidewalk	3.06	38.0
Getting over curbs	2.90	40.9
Getting transportation back home	2.90	43.4
Getting in and out of the building at the destination	2.85	35.8
Getting robbed or mugged	2.77	34.4
Getting around inside the building at the destination	2.73	29.1
Crossing an intersection	2.70	31.7
Hilly sidewalks	2.65	33.5
Cost of trip	2.54	25.9
Getting over or around bumps in a sidewalk	2.50	24.8
Heavy auto traffic	2.48	26.7
The weather	2.31	17.9
Getting lost	2.29	23.5
Crowded sidewalk	2.23	18.1
Getting someone for accompaniment on trip	2.13	20.0
Being embarrassed by the disability	1.61	6.2

[a]Based on a scale from 1 to 5, where 1 = "no concern at all," and 5 = "of greatest concern."

[b]Percent of respondents marking either 4 (very concerned) or 5 (of greatest concern) on the scale.

SOURCE: Mail survey of transportation handicapped people registered with one of 10 national private, nonprofit social service organizations, conducted for NCHRP Project 8-27.

Table 32. Concerns of wheelchair users in planning a trip, compared to other transportation handicapped people.

	Wheelchair Users		Other Trans. Hand. People		
Travel Concerns	Average Degree of Concern[a]	Percent of People Having a Major Concern[b]	Average Degree of Concern[a]	Percent of People Having a Major Concern[b]	Difference in the Average Degree of Concern
Getting over curbs	3.91	69.1	1.85	11.5	+2.06
Getting in and out of the building at the destination	3.57	54.2	2.10	16.5	+1.47
Getting around a place that has no sidewalk	3.53	53.0	2.58	22.5	+0.95
Getting transportation to the destination	3.23	47.6	2.99	37.7	+0.24
Getting around inside the building at the destination	3.19	42.2	2.27	15.9	+0.92
Getting transportation back home	3.16	50.0	2.62	36.4	+0.54
Getting over or around bumps in a sidewalk	2.99	38.6	1.97	10.3	+1.02
Crossing an intersection	2.93	40.5	2.46	22.5	+0.47
Hilly sidewalks	2.90	41.0	2.38	25.6	+0.52
Getting robbed or mugged	2.86	37.3	2.68	31.2	+0.18
Cost of trip	2.77	31.0	2.28	20.5	+0.49
Getting someone for accompaniment on trip	2.40	27.7	1.84	11.7	+0.56
Heavy auto traffic	2.40	24.1	2.56	29.5	-0.16
Crowded sidewalk	2.30	20.5	2.14	15.6	+0.16
Getting lost	2.27	22.6	2.31	24.4	-0.04
The weather	2.23	17.9	2.41	17.9	-0.18
Being embarrassed by the disability	1.63	8.4	1.59	3.8	+0.04

[a]Based on a scale from 1 (no concern at all) to 5 (of greatest concern).

[b]Percent of respondents marking either 4 (very concerned) or 5 (of greatest concern) on the scale.

SOURCE: Mail survey of transportation handicapped people registered with one of 10 national private, nonprofit social service organizations, conducted for NCHRP Project 8-27.

more concerned about curbs, access to buildings, and places without sidewalks. Compared to other transportation handicapped people, wheelchair users also give much more consideration to getting over or around rough areas in sidewalks, getting around inside buildings, getting someone to accompany them on their trips, getting transportation for the return trip, and negotiating hilly terrain. On most items, the wheelchair users expressed a greater degree of concern than did the other transportation handicapped people in the sample. For some items, however, the two groups shared the same degree of concern. These included the possibility of getting robbed or mugged, crowded sidewalks, embarrassment over one's disability, fear of getting lost, heavy automobile traffic, and the weather. Most of these items, however, were only minor considerations for people in both groups.

These findings may not be representative of the transportation handicapped population in general. The sample consisted entirely of people who receive some type of assistance or service from private, nonprofit organizations that serve the needs or represent the interests of various handicapped people. Table B-16 in Appendix B shows that these people traveled much more frequently than the average transportation handicapped person. Table B-1 indicates that the people in the sample were younger and more educated than transportation handicapped people in general. The above findings from the mail survey, therefore, cannot be projected to the entire transportation handicapped population. A random sample of handicapped persons might yield different results.

The in-depth interviews with five transportation handicapped people in the Knoxville, Tennessee, area provided some additional insight into the factors that influence travel behavior. Transcripts of these interviews are included in Appendix C. Table 33 contains a profile of each person interviewed, indicating, among other things, how often he or she now travels, what means of transportation he or she now uses, and what effect his or her economic status has on his or her mobility. Table 34 indicates the factors these individuals considered before undertaking certain kinds of trips, while Table 35 shows the factors these people considered when traveling in general.

The results of these interviews obviously cannot be extrapolated to cover the entire transportation handicapped population. In fact, the interviews suggest that handicapped persons have their own individual concerns about travel, depending not only on their individual physical capabilities and limitations, but also on their attitudes, interests, and experiences.

Effects of Transportation on Activity

The findings on latent travel demand showed that the existence of a barrier-free transportation system would increase the frequency of travel of transportation handicapped people by only a fraction of their current rate of travel. This suggests that other factors besides transportation determine the activities of transportation handicapped people and how often they engage in these activities. At least two studies provide some information about the relative importance of transportation on the amount of activity of transportation handicapped people.

In his survey of elderly and physically handicapped people on the north side of Chicago, Miller (20) measured the extent to which transportation affected the ability of each respondent to participate in certain activities. A summary of his results is presented in Table 36. For every activity listed, less than one-third of the respondents indicated that transportation was a factor affecting participation. This suggests that a barrier-free transportation system may not have a large effect on the amount of travel by transportation handicapped people for these activities.

A comparison of Table 36 with Table 22 reveals a close correspondence between the activities for which transportation was more likely to be a factor affecting participation and the activities in which more people desired to participate more often. Evidently, if there is a latent demand for an activity, transportation is more likely to be a factor affecting participation in that activity. There is, however, one noticeable and significant exception to this generalization. Whereas Table 22 shows that 35 percent of the respondents expressed a desire either to begin going to work or to go to work more often, Table 36 shows that only 10 percent indicated that transportation was a factor affecting their ability to go to work. A barrier-free transportation system by itself, therefore, may not induce large numbers of transportation handicapped people to seek employment.

Table 33. In-depth personal interviews: profile of five persons interviewed

Characteristic	Respondent A	Respondent B	Respondent C	Respondent D	Respondent E
Age	71	68	79	30	35
Sex	Female	Female	Female	Female	Male
Educational level	7th grade	6th grade	Business school	College degree	Master's degree
Marital status	Widow	Widow	Widow	Single	Single
Handicap	Arthritis; difficulty walking	Arthritis; nervous breakdown	Poor eyesight; difficulty walking	Spinal bifida; confined to wheelchair	Quadriplegic; confined to wheelchair
Employment status	Retired	Retired	Retired	Employed full-time	Employed full-time
Type of residence	Single family home	Trailer	Apartment	Apartment	Single family home
Drivers' license	No	No	No	Yes	No
One-way trips per Week	6	6	7	14	16
Means of transportation used	Agency van; cars of friends or neighbors	Agency van; neighbor's car for trips to church	Agency van; son's car for shopping trips; walking	Drives own modified car; travels in wheelchair	Owns a van; lives with driver
Effect of economic status on mobility	Insufficient income to travel by cab to desired destinations	Totally dependent on neighbors and agency van for transportation	Insufficient income limits travel to only church and grocery store	Limits mileage; depends on legacy from relative to afford van	Income is sufficient to own van and afford a driver

Table 34. In-depth personal interviews: travel considerations by trip purpose

Respondent	Work Trips	Trips for Grocery Shopping	Medical Trips	Trips to Recreational Activities
A	Does not make work trips	Shops at stores selected by friends or neighbors who provide the transportation	Goes to a doctor close to her residence	Limited to senior citizens center and church functions; senior citizens center has an agency van; church members provide transportation to church activities
B	Does not make work trips	Shops at store close to residence; generally shops on way home from senior citizens center	Must seek transportation two or three days before appointment; gets prescriptions filled at pharmacy near home	Limited to senior citizens center; uses agency van
C	Does not make work trips	Relies on son to take her to grocery stores; son helps her get in and out of store and with food selection	Relies on son to take her to medical appointments on his day off; otherwise, uses local publicly operated specialized transportation service; takes a cab only if no other transportation available	Limited to senior citizens center; uses agency van
D	Seeks parking space close to building; must worry about obstacles between parking space and building entrance	Looks for convenient parking; width of checkout lanes is critical	Accessibility of doctor's office, particularly curb cuts, ramps, available parking	Most recreation is done with friends who provide transportation and other assistance; otherwise, engages in recreational activities at home
E	Must coordinate arrival and departure times with work schedule of personal driver	Looks for convenient parking; width of checkout lanes is critical	Availability of parking for handicapped people; ease of getting in and out of building	Choices not restricted if accompanied by two or three friends; otherwise, must consider such factors as accessibility of building, table height in restaurants, crowding, layout

Table 35. In-depth personal interviews: factors considered when traveling

	Respondent				
	A	B	C	D	E
Weather	X			X	
Getting transportation	X	X	X		X[a]
Hilly sidewalks	X	X		X	X
Getting in and out of buildings at destination			X	X	X
Getting around inside building at destination			X	X	X
Crossing an intersection					
Getting over curbs	X			X	X
Getting over or around bumps in sidewalk	X				X
Getting lost					
Getting transportation home	X		X		
Heavy auto traffic					
Getting robbed or mugged					
Being embarrassed because of disability				X	
Cost of trip			X		
Crowded sidewalks					
Restroom facilities					
Carrying medication or equipment related to disability	X				X

[a]Getting transportation is a concern only when personal van and driver are unavailable.

Table 36. Transportation as a factor affecting participation in various activities by elderly and handicapped persons on Chicago's north side.

Activity	Percent of Respondents Claiming Transportation Affects Participation in Activity
Visit friends or relatives	31
Go to zoo	28
Go out to eat	27
Go to museum or art gallery	27
Shop for groceries	26
Go to church, temple, or synagogue	26
Go to movie	22
Go to public meeting, hearing, lecture, or speech	20
Visit city or government offices	20
Shop downtown	19
Go to ballgame	18
Go to library	18
Shop for clothes	17
Go to beach	14
Go to work	10
Go to barber or hairdresser	9
Go to school	6
Go to doctor or dentist	2
Go to bank	1

SOURCE: Ref. 20.

The UMTA national survey (8) determined the main reasons why many transportation handicapped people do not work. As Table 37 clearly shows, a lack of transportation is definitely not a major factor. It appears from these results that a large number of transportation handicapped people between the ages of 16 and 64 either prefer not to work or believe that their disabilities prevent them from working. Transportation might become a more important factor if more transportation handicapped people enter the job market.

Table 37. Reasons for not working given by unemployed transportation handicapped people between the ages of 16 and 64.

Reasons for not Working	Percent of Unemployed Transportation Handicapped People 16-64 Years of Age Citing Reason[a]
Keeping house/family responsibilities	49
Unable to work	36
Physical disability/ill health	28
Going to school/training	14
Lack of education or training	2
Too young or too old according to employers	2
Other personal handicaps	2
Lack of transportation	1

[a]Percentages add to more than 100% because transportation handicapped persons often cited more than one reason.

SOURCE: UMTA National Survey of Transportation Handicapped People, Ref. 8.

IMPORTANCE OF TRANSPORTATION RELATIVE TO OTHER NEEDS

Transportation handicapped people generally have other unmet needs besides the need for better transportation. Some of them may also desire more educational opportunities, wider choices in housing, better health care, more employment opportunities, more opportunities for recreation, better streets and roads, and better police protection. Public transportation must share available financial resources with schools, housing programs, training programs, parks and recreational areas, streets and highways, health care programs, and police departments. Therefore, in deciding how to allocate available funds, state and local planners and decision-makers may find it useful and interesting to know the extent to which transportation handicapped people believe they would benefit from improvements in each of the above areas.

In the mail survey of transportation handicapped people conducted for this project, the psychometric scaling technique of paired comparisons was used to determine the relative importance of each of the items mentioned above, as perceived by transportation handicapped people. The resultant scaled rankings are shown in Figure 1 for all transportation handicapped people in the sample as well as for wheelchair users and those transportation handicapped people who do not use wheelchairs.

Three areas of need were clearly prominent in the full sample--public transportation, employment, and health care. Most respondents believed they would benefit more from improvements in these three areas than from improvements in any of the other five areas shown. Housing, education, and police protection were much less important areas of need, although improvements in these areas were considered more beneficial than better streets and roads and more recreational opportunities.

Figure 1 reveals some striking differences in the perceived needs of wheelchair users and the other transportation handicapped people in the sample. The former group preferred better public transportation much more often than the latter group. A majority in both groups chose better public transportation over each of the other choices, but the percentage of wheelchair users preferring public transportation was higher in every case except housing. Persons not in wheelchairs were more likely to choose more employment opportunities and better health care than were wheelchair users over most of the other areas. Compared to the other transportation handicapped people in the survey, the wheelchair users perceived much greater benefits from wider choices in housing and more educational opportunities. On the other hand, they perceived fewer benefits from better police protection and better streets and roads than did the other transportation handicapped people surveyed.

Much of the emphasis of previous planning and research in the area of transportation for handicapped people has been on the transportation needs of wheelchair users. Although these people constitute a minority of the transportation handicapped population, the results of the paired comparisons analysis of perceived needs suggest that this emphasis has not been misplaced. Wheelchair users do have serious transportation problems, and they do regard better public transportation as being highly beneficial to them.

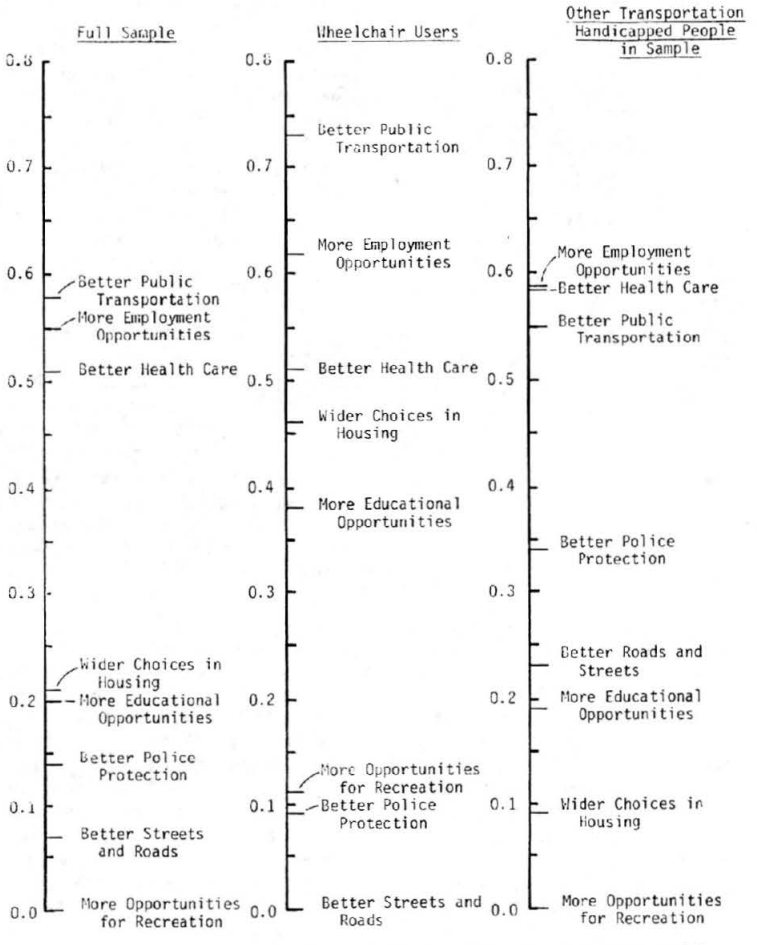
SUMMARY

Transportation handicapped people travel much less often than the general public. Data from various surveys indicate that transportation handicapped people on the average take less than half as many trips as other people.

Within the transportation handicapped population, however, the amount of trip-making varies considerably. Persons in wheelchairs and other severely handicapped persons travel less frequently than persons who are only moderately or slightly handicapped. The most significant determinants of trip-making, however, are household income, employment status, availability of an automobile, and ability to drive. Transportation handicapped people who live in households with more than $15,000 annual income, who are employed, who usually have cars available when they need them, or who are licensed to drive are much more mobile than other transportation handicapped people.

Much of the difference between the average trip rates of transportation handicapped people and other people in the urban population can be explained by the fact that a large majority of transportation handicapped people do not make any work trips. The average daily work trip rate of transportation handicapped people 16 years of age or older is about one-fourth that of people in this age group who are not transportation handicapped. On the other hand, the average daily trip rate of transportation handicapped people for nonwork trips is about 70 percent of the nonwork trip rate of other people. The gap between the nonwork trip rates, therefore, is much smaller than the gap between the work trip rates. Barrier-free transportation services, therefore, could have a much greater impact on the mobility of transportation handicapped people if they enabled larger numbers of transportation handicapped people to work than if they simply enabled transportation handicapped people to make a few more nonwork trips.

Available evidence on the latent travel demand of transportation handicapped people suggests that barrier-free transportation services will not greatly increase the rate at which these people travel. Previous measures of latent demand, or the additional number of trips that transportation handicapped people would like to make, indicate that it is only a fraction of the current rate of trip-making.



SOURCE: Mail survey of handicapped clients of 10 national private social service organizations, for NCHRP Project 8-27.

Figure 1. Paired-comparisons ranking of perceived needs of transportation handicapped people.

This implies that transportation handicapped people are already making a majority of their desired trips. If the latent travel demand could be fully satisfied by a barrier-free transportation service, the resulting average daily trip rate would still be much lower than that of the general public.

Transportation handicapped people seem to have a greater latent demand for social and shopping trips than for work trips. Thus, it does not appear that barrier-free transportation services will induce very many transportation handicapped people to seek employment. In fact, a lack of transportation seldom explains why a transportation handicapped person is unemployed.

Although better public transportation is important to many transportation handicapped people, previous research has indicated that there is a limit to what a barrier-free transportation system can do to increase the mobility of these people. Transportation handicapped persons face numerous other barriers to mobility besides lack of accessible transportation. Wheelchair users, in particular, are just as concerned about negotiating curbs and getting in and out of buildings as they are about getting transportation. Furthermore, transportation often does not have an effect on a transportation handicapped person's ability to participate more often in various activities. Although barrier-free transportation must be available before some transportation handicapped people will be able to travel more often, numerous other architectural, physical, economic, psychological, and institutional barriers must also be overcome before the mobility of transportation handicapped people will be greatly improved.

CHAPTER FOUR

FINDINGS: ALTERNATIVE TRANSPORTATION SOLUTIONS, THEIR COSTS AND THEIR EFFECTIVENESS

Several general approaches to solving the transportation problems of transportation handicapped people have been suggested in the past. They include the following:

- Modification of existing fixed-route transit facilities and services to make them more accessible to handicapped people.
- Special, fully accessible, door-to-door transportation services.
- Individual subsidies to transportation handicapped persons to help them pay for transportation services that they can use.
- Programs to train transportation handicapped persons--particularly blind persons and mentally retarded people--in the use of conventional transit services.
- Programs to facilitate the use of personal vehicles by transportation handicapped persons.

Various combinations of these approaches are also possible for different segments of the handicapped population.

This chapter discusses the first four of the foregoing approaches. It describes each alternative separately and presents data on the cost and effectiveness of each. These data reflect the experience of transit operators, local governments, and other agencies that have implemented the above solutions. The discussion of fixed-route transit systems is limited to local bus services. Heavy rail transit, light rail transit, commuter railroads, and intercity bus services are not included. The discussion of individual subsidies to transportation handicapped people focuses on taxicab user-side subsidy programs, in which transportation handicapped people are given trip tickets or vouchers which they can use to purchase taxicab services at a reduced fare.

This chapter does not evaluate the cost-effectiveness of the alternative solutions. Its main purpose is to show what the cost and the effectiveness of each alternative have been based on previous experience. Another purpose is to indicate the options available under each alternative and how the cost and the effectiveness of each solution have varied in practice. The evaluation and comparison of the cost-effectiveness of the alternative solutions is left to Chapter Five.

Chapter Four concludes with a discussion of the perceptions of transportation handicapped people toward various modal attributes. It indicates the characteristics of transportation services that transportation handicapped people consider to be important as well as those they regard as relatively unimportant. It also provides some insight into the attitudes or preferences of transportation handicapped people toward some of the alternatives described in this chapter.

DESCRIPTION OF THE ALTERNATIVES

Accessible Fixed-Route Bus Systems

The concept of an accessible fixed-route bus system often brings to mind the image of buses with wheelchair lifts. Lift-equipped vehicles, however, are only one element of an accessible bus system. In general, the major components of an accessible bus system include:

- Buses
- Transit facilities
- Bus stops
- Personnel training
- Marketing and information systems
- Transit operations.

Table 38 summarizes the various features, subsystems, programs, policies, practices, and other provisions that together constitute an accessible fixed-route bus system. Rosenbloom (15), Booz, Allen and Hamilton, Inc. (16,29), Crain and Associates (30), and Hooper (31) provide more detailed information on some of the elements of accessible fixed-route bus systems. Booz, Allen and Hamilton, Inc. (29) also provide guidelines on planning and implementing accessible fixed-route bus systems.

Most elements of an accessible fixed-route bus system address the needs of specific market segments of the transportation handicapped population. Table 38 indicates which handicapped people are most likely to benefit from or be affected by an element. Some of the elements can benefit other bus riders besides those who are handicapped. Examples include slip-resistant floor and step surfaces; interior and exterior lighting; large, illuminated route and destination signs; accessible pressure-sensitive signal tapes; highly visible bus stop signs or markings; bus shelters; and smoother starting, stopping, and cornering. The cost of many of these improvements in the bus system, therefore, cannot be totally ascribed to serving the needs of handicapped people.

Specialized Transportation Services

Specialized transportation services have been defined as those forms of intraurban passenger transportation that:

- Can accommodate or are specifically designed for handicapped people.
- Are distinct from conventional fixed-route, fixed-schedule bus service.
- Can operate over existing streets and highways (30).

They usually provide door-to-door transportation, thereby mitigating or eliminating the problems of getting to and from the vehicles. They are often called demand-responsive transportation services because, unlike conventional fixed-route, fixed-schedule bus systems, they usually operate by responding to requests for service. However, under the above definition, demand-responsive transportation services are only one form of specialized transportation service. Other forms include carpools, vanpools, buspools, and various subscription services. In fact, it is even possible under the above definition to have a fixed-route, fixed-schedule bus service designed specifically and

Table 38. Elements of an accessible fixed-route bus system.

Element	Persons Most Likely to Benefit from or be Affected by the Element
Buses	
• Wheelchair lifts or ramps	• Wheelchair users; semiambulatory persons
• Bus kneeling mechanism	• Semiambulatory persons
• Wheelchair securement devices	• Wheelchair users
• Placement of the farebox to allow clearance for wheelchairs	• Wheelchair users
• Number and placement of poles and handrails	• Semiambulatory persons; wheelchair users
• Slip-resistant floor and step surfaces	• Semiambulatory persons; persons with limited or no use of hands or arms; persons with poor vision; blind persons; wheelchair users
• Interior and exterior lighting	• Persons with poor vision; semiambulatory persons
• Large, illuminated route and destination signs	• Persons with poor vision; mentally retarded persons
• Accessible signal cord or pressure-sensitive signal tape	• Wheelchair users; semiambulatory persons; persons with limited use of hands or arms
• Automatic exit doors	• Persons with limited or no use of hands or arms; semiambulatory persons
• Public address systems	• Blind persons; persons with poor vision
• Padded and rounded edges and corners	• Wheelchair users; semiambulatory persons; blind persons; persons with poor vision
Terminals, Park-and-Ride Areas and Customer Information Centers	
• Facilities designed in accordance with: - Proposed Uniform Federal Accessibility Standards, Federal Register, April 29, 1983 - American National Standards Institute, "Specifications for Making Buildings and Facilities Accessible to, and Usable by, the Physically Handicapped," ANSI A117.1-1980 - Architectural and Transportation Barriers Compliance Board, "Minimum Guidelines and Requirements for Accessible Design," Federal Register, August 4, 1982.	• Wheelchair users; semiambulatory persons; blind persons; persons with poor vision; deaf persons; persons with poor hearing; persons with limited use of hands or arms
Bus Stops	
• Removal of obstructions	• Wheelchair users; semiambulatory persons; blind persons; persons with poor vision
• Highly visible bus stop signs or markings	• Persons with poor vision; mentally retarded persons
• Level, paved boarding area	• Wheelchair users; semiambulatory persons; blind persons; persons with poor vision
• Lighting	• Wheelchair users; semiambulatory persons; persons with poor vision
• Shelters	• All transit passengers
• Sensing devices that activate a light or a sound pulse when a bus approaches	• Blind persons; persons with poor vision; deaf persons; persons with poor hearing
• Talking signs (infrared light transmitter and receiver)	• Blind persons; persons with poor vision
• Curb cuts	• Wheelchair users; semiambulatory persons
• Audible street crossing devices	• Blind persons
Transit Personnel Training	
• Lift operation and maintenance	• Wheelchair users; semiambulatory persons
• Sensitivity training	• All transportation handicapped persons
• Proper methods of providing assistance	• Wheelchair users; semiambulatory persons
• Periodic retraining	• All transportation handicapped persons

Table 38. (Continued).

Element	Persons Most Likely to Benefit from or be Affected by the Element
Marketing and Information	
• Lift user training	• Wheelchair users; semiambulatory persons
• Brochures describing the accessible fixed-route bus system and how to use it	• Wheelchair users; semiambulatory persons
• Timetables showing which trips are made by lift-equipped buses	• Wheelchair users; semiambulatory persons
• Maps showing the network of routes served by lift-equipped buses	• Wheelchair users; semiambulatory persons
• Teletypewriter (TTY) machines	• Deaf persons; persons with poor hearing; person with speech impairments
• Auditory route maps (cassette tapes with instructions for individual routes)	• Blind persons
• Tactile route maps consisting of Braille, raised symbols, and large print	• Blind persons; persons with poor vision
• Braille bus schedules	• Blind persons
• Braille and large-print brochures of transit information	• Blind persons; persons with poor vision
Operating Procedures, Policies, and Practices	
• Reduced fares	• All transportation handicapped persons
• Prepayment of fares	• Wheelchair users; semiambulatory persons; persons with limited or no use of hands and arms; blind persons; mentally retarded persons
• Priority seating	• Semiambulatory persons; persons with limited or no use of hands and arms; blind persons; mentally retarded persons
• Waiting until handicapped persons are seated before moving bus	• Wheelchair users; semiambulatory persons; persons with limited or no use of hands and arms; blind persons; persons with poor vision
• Driver assistance	• All transportation handicapped persons
• Order of boardings of handicapped and other passengers	• Wheelchair users; semiambulatory persons
• Use of the lifts and bus kneeling mechanisms, including the circumstances under which they may be deployed and the people allowed to use them	• Wheelchair users; semiambulatory persons
• Accommodation of escorts, guide dogs, and special aids	• Wheelchair users; semiambulatory persons; blind persons
• Safety and emergency procedures	• All transportation handicapped persons
• Scheduling and dispatching of lift-equipped buses	• Wheelchair users; semiambulatory persons
• Testing, maintenance, and security of lifts and other accessibility features	• Wheelchair users; semiambulatory persons
• Smoother starting, stopping, and cornering	• Wheelchair users; semiambulatory persons; persons with limited or no use of hands and arms; blind persons

SOURCE: The list of elements was compiled from References 15, 16, 19, 30, and 31.

exclusively for handicapped people. The latter type of specialized transportation service can be found, for example, in Atlanta (32).

The literature shows that there are many alternative forms of specialized transportation service and many alternative ways of providing it. Table 39 summarizes the characteristics of this alternative and indicates some of the more important ways in which existing specialized transportation services differ from each other.

Table 39. Variable characteristics of specialized transportation services.

Types of Service:	• Prescheduled demand-responsive--provided in response to a request for service made at least two hours or, more commonly, one or two days in advance of the desired departure time • Immediate service--provided immediately in response to a request for service • Subscription service--automatically provided at a prearranged time and place to serve repetitive or regularly scheduled trips • Group service--prearranged transportation of a group of people traveling between the same origin and destination
Routing:	• Dynamic routing • Fixed routes
Trip Reservation and Scheduling:	• Advance reservation - Anywhere from two hours to two weeks in advance - Typically one or two days in advance • No advance reservation required - Medical emergencies and return trips only - Only trips that can easily be inserted into the schedule of prearranged trips - All trips
Types of Trips Served:	• All trip purposes accepted on the basis of space available • Certain trip purposes receive a higher priority than others • Certain trip purposes explicitly excluded • Regularly scheduled daily or weekly trips only • Restrictions on length of trips
Origins and Destinations Served:	• Many-to-many--serves many different origins and destinations • Many-to-few--serves many different origins but only a few specified destinations • Many-to-one--serves many different origins but only one destination
Eligibility Criteria:	• Type of disability - Any type of disability - Only certain types of disability - Not limited to only people with a disability • Ability to use public transit - Restricted to persons who cannot use regular fixed-route bus service because of a disability - Restricted to persons who either cannot use or would have difficulty using regular fixed-route bus service because of a disability - No restrictions • Age - All ages - Restricted to persons above a certain age (60, 62, or 65) • Income - Restricted to persons with incomes below a specified level - No restrictions • Social service agency affiliation - Restricted to clients of social service agencies or recipients of Title XX social service programs - No social service agency affiliation required • Various combinations of the above criteria
Types of Personal Assistance:	• Door-through-door--assistance in and out of buildings, to and from vehicles, and into and out of vehicles • Door-to-door--assistance to and from vehicles, and into and out of vehicles • Curb-to-curb--assistance into and out of vehicle only
Size of Service Area:	• Selected neighborhoods or districts • City limits • Central city and certain suburban communities • County limits • Cluster of small towns or suburban communities • Group of contiguous counties • Metropolitan area • State
Subdivision of Service Area:	• Service zones, sectors, or modules • Inner ring, outer ring • No subdivision
Fare Schedules:	• Flat fare • Zone fare or distance-based fare • Typical base fares range between 15¢ and $1.00 • Service may be free to clients of social service agencies • No fare required but donations accepted
Types of Vehicles:	• Standard model passenger sedans • Station wagons • Vans--standard or modified • Small buses (less than 25 passengers)--standard or modified • Medium-sized buses (25-35 passengers)--standard or modified • School buses • Full-size urban transit buses--standard or modified
Management and Operation:	• Lead agencies - Social service agency - Private, nonprofit agency, corporation, or foundation - Agency or department of city or county government (usually department of welfare or human resources) - Specialized transportation authority - Public transit operator - Transportation broker • Operating agencies - Social service agency - Private, nonprofit agency, corporation, or foundation - Public transit operator - Private transit management company - Taxicab company

SOURCE: Compiled from References 5, 6, 30, 32, 33, 34, and 35.

User-Side Subsidies for Taxi Service

The third major alternative way of improving the mobility of transportation handicapped people is to provide them with individual subsidies that allow them to purchase available transportation from private carriers at reduced fares. Because the users rather than the providers of transportation are subsidized under this approach, this form of subsidy is referred to as a user-side subsidy. Persons eligible for the subsidy pay only a portion of the full fare for the trips they take via the participating transportation providers. The latter are then reimbursed for the remainder of the fare by the subsidizing agency. In most cases to date, the private carriers have consisted of taxicab companies, although in a few instances other types of private transportation service providers have also been involved.

One of the chief advantages of user-side subsidies over the more traditional method of subsidizing transit providers is the fact that the subsidizing agency does not spend any funds for unused capacity or service. The total subsidy depends on the demand for the available transportation services. If the demand is low, the cost of subsidizing the travel of eligible persons will also be low.

User-side subsidies can be beneficial for both the users and the participating service providers. They can lower the cost of travel to handicapped people, thereby enabling these people to travel more often. To the extent that the subsidies generate trips that might not otherwise have been taken, they can increase the revenues of the participating private carriers.

Like specialized transportation services, user-side subsidy programs have had many variations. Several mechanisms for administering the subsidies have been employed. Fare schedules and limits on

the amount of individual subsidies have also varied among existing programs. These and other aspects of the user-side subsidy alternative are summarized in Table 40.

Table 41 indicates the number of participating taxi companies and the number of vehicles available for several user-side subsidy programs.

Subsidizing agencies generally have tried to enlist the participation of all private carriers within the program area. Table 41 shows, however, that not all taxi companies decided to get involved in the programs. In Montgomery, Alabama, for example, a number of taxi companies declined to participate because they were not willing to convert from a meter system to a fine-grained grid fare structure for project trips (36). The largest cab company in Kansas City decided not to become involved in the Share A Fare program because the subsidizing agency could not guarantee two riders per trip. Several smaller cab companies in Kansas City elected not to participate because they did not have enough vehicles to handle their regular riders as well as the program riders (41). Taxi operators have also withdrawn from some user-side subsidy programs. Several taxi companies dropped out of the program in Montgomery, Alabama, because of problems with the voucher system. The cab operators contended that the need for drivers to complete vouchers at the end of project trips was causing delays in service. They also complained that they were not being promptly reimbursed because of delays caused by the process of verifying the vouchers (36). In Kansas City, four cab companies originally enlisted in the Share A Fare program. Three of the original participants withdrew while another company eventually joined the program (41). In general, however, the user-side subsidy programs have been popular with the private carriers that have participated in them.

Table 40. Variable characteristics of taxi user-side subsidy program.

Subsidy Mechanisms:	• Tickets - Suitable for either a flat fare schedule or a simple zonal fare schedule in which interzonal charges are integral multiples of the base fare - Each ticket is worth either a one-way taxi trip or a single zone fare • Scrip - Suitable for more complicated zonal fare schedule - Issued in multiple denominations • Vouchers - Suitable for meter-based fare schedules and zonal fare schedules with large numbers of small zones - Completed and signed by taxi drivers at the end of each passenger trip
Subsidy Outlets:	• Main office of subsidizing agency • Purchase by mail • Senior citizen and handicapped person activity centers • Field offices of subsidizing agency • Selected stores • Combinations of the above
User Fare Schedule:	• No payment of fare required (Santa Clara County, CA) • Flat fare • Base fare plus any amount over the maximum subsidy per trip • Fixed percentage of total fare
Group Riding Policies:	• Groups of eligible persons allowed to ride together between the same origin and the same destination for a single fare
Limits on Subsidy per Trip:	• No limit • Users responsible for any charges over a specified amount on the taxi meter • Users responsible for any charges for that portion of a trip exceeding a specified length
Limits on Amount of Subsidized Travel:	• No limit • Monthly, quarterly, or yearly limit on the number of subsidized taxi trips an eligible person may take or on the amount of tickets or scrip an eligible person may purchase
Trip Purpose Restrictions:	• Usually no restrictions • May be limited to medical, shopping, social service, and personal business trips; other trips are implicitly excluded • Certain trips (e.g., social-recreation) may be explicitly prohibited
Trip Reservations and Scheduling:	• Advance reservations usually not required • May require notification at least one hour in advance (e.g., Montgomery, AL) • May require trip reservations one day in advance (e.g., Kansas City; Santa Clara County, CA)
Eligibility Criteria:	• Type of disability - May be limited to persons with certain types of disability (e.g., wheelchair users, blind persons, persons needing walkers or crutches) - Persons with certain types of disability (e.g., mental retardation) are explicitly excluded • Ability to use public transit--may be restricted to persons unable to use regular public transit because of a disability • Ability to drive a car--may be restricted to persons unable to drive a car because of a physical disability • Ability to ride in a taxi--may be restricted to persons able to ride in a taxi • Age--may be restricted to persons at or above a specified age (e.g., 18, 60, 65) • Income--may be restricted to persons with incomes below a specified level (e.g., 70 percent of median income in the state) • May be restricted to persons eligible for Medicare or Social Security disability insurance • Combinations of the above criteria
Accommodation of Wheelchair Users:	• No special provisions for wheelchair users who are unable to ride in taxis • Private, for-profit carriers specializing in the transportation of wheelchair users (i.e., chair car companies) may be involved in the taxi user-side subsidy program) • Lift-equipped vans for people unable to ride in taxis
Types of Personal Assistance:	• Usually only assistance getting into and out of the taxis is provided (i.e., curb-to-curb assistance) • A few programs provide assistance between the doorstep and the vehicle (i.e., door-to-door assistance)
Subsidizing Agencies:	• Agencies of local or state government • Independent organizations reporting directly to a local government agency or department • Public transit operator • Transportation broker
Types of Service Providers:	• Taxi operators • Private, for-profit carriers specializing in the transportation of wheelchair users • Private nonprofit agencies

SOURCE: Compiled from References 36, 37, 38, 39, 40, 41, 42, and 43.

Mobility Training

Many blind persons and mentally retarded individuals can use existing conventional fixed-route bus systems if they have been properly trained to do so. There are an estimated 6 million mentally retarded persons in the United States, comprising roughly 3 percent of the total population. The vast majority of these people--approximately 89 percent--are only mildly retarded. They can be educated and can learn to live independently. Hence, they can also be trained to use conventional bus transit systems on their own. In fact, only 3 percent of

Table 41. Numbers of service providers and vehicles engaged in taxi user-side subsidy programs.

Program Location	Number of Taxi Firms in Program Area	Number of Taxi Firms Participating in Program	Number of Vehicles in Program
Danville, Illinois (43)	2	2	24
Montgomery, Alabama (43)	16	3	47
Kinston, North Carolina (43)	10	8	33
Lawrence, Massachusetts (43)	10	8	63
Milton Township, Illinois (43)	N.A.	2	14
Kansas City, Missouri (41)	8	2[a]	120
Los Angeles Harbor Area (43)	N.A.	1	35
San Leandro, California (37)	N.A.	1	32
Santa Clara County, California (37)	3	2	43
Sunnyvale, California (37)	N.A.	1	13
Palo Alto, California (37)	2	1	25
Lafayette, California (37)	1	1	2
Fremont, California (37)	N.A.	1	N.A.
Pittsburgh, Pennsylvania (40)	N.A.	3[b]	N.A.

[a]In addition to the two taxicab companies, three private nonprofit transportation providers and Medicab, a private for-profit transportation service with five lift-equipped vans that specializes in the transportation of wheelchair users and persons confined to a bed, also participate in the Kansas City Share A Fare program. Three city-owned vans are also used in the program.

[b]Four private nonprofit carriers are also under contract with ACCESS, the private transportation brokerage firm that administers the user-side subsidy program.

SOURCE: References indicated by the underlined numbers in parentheses.

all mentally retarded persons, consisting of those who are either severely or profoundly retarded, most likely would never be able to travel by themselves on a fixed-route public bus system (44).

Mobility training programs are nothing new. Programs to teach blind people and mentally retarded persons how to travel locally by themselves have been in existence for many years. Many organizations have become quite experienced in providing mobility training, including the Center for the Retarded, the Easter Seals Society, the Cerebral Palsy Foundation, and many volunteer organizations devoted to the needs of mentally retarded persons.

A number of mobility training programs for mentally retarded persons have been developed. The curriculum, however, is basically the same in each case. The standard program consists of training in becoming familiar with the bus route, identifying the correct bus, handling money and paying the fare, using the signal cord, and recognizing when to get off the bus. Many programs require that the retarded person be able to recognize numbers, to tell time, and to have already acquired certain pedestrian skills such as knowing how to cross streets. On-site training with one pupil at a time is generally recommended. Pupils usually make many practice trips accompanied by the instructor. When the pupil appears to be ready to make a bus trip on his or her own, the instructor usually covertly observes the first few unescorted trips by following the bus in a car (44, 45).

Mobility training programs may have several potential benefits (44). They are consistent with the current goal of federal and state governments to reduce the number of mentally retarded persons in institutions as much as possible. They obviate the need to provide specialized transportation services for people who can be trained to use existing, conventional bus transit systems. Moreover, they will reduce the demand for specialized transportation services that are already operating at capacity, thereby improving the level of service for those who do require special transportation. Many specialized transportation systems only serve certain destinations such as sheltered workshops and social service agencies. By training mentally retarded persons to use public bus systems that serve many destinations, these people will be better able to seek and gain productive employment and to take advantage of more educational and recreational activities. Finally, mobility training programs can enhance a retarded individual's feeling of self-esteem.

The role of a transit operator in a mobility training program can vary. The transit operating agency could conduct its own program. Alternatively, it could support an existing program by providing complimentary bus passes to instructors and pupils.

COSTS OF THE ALTERNATIVES

Accessible Fixed-Route Bus Systems

The provision of accessible fixed-route bus service entails some additional cost to the transit operator. These additional costs include the following:

- The capital cost of wheelchair lifts, kneeling mechanisms, wheelchair securement devices, and other accessibility features.
- Administrative staffing cost associated with the assignment of one or more persons to planning, marketing, implementing, and monitoring accessible bus service.
- Additional operating cost due to schedule changes and service delays.
- Additional maintenance and inspection cost, including the cost of additional maintenance personnel.
- Transit personnel training cost.
- Cost of marketing and promoting the accessible bus service; and
- Additional insurance cost and claims settlements.

Capital Costs

Accessible fixed-route bus systems may incur additional capital costs for the following items:

- Wheelchair lifts.
- Kneeling mechanisms.
- Wheelchair securement devices.
- Extra stanchions and handrails.
- Signs for reserved seating
- Slip-resistant flooring.
- Lower signal cords or special stop-call buttons.
- Auxiliary equipment, such as supervisors' vans.
- Maintenance facility remodeling.
- Bus stop remodeling, including modifications to existing shelters.
- TTYs.

Data on the cost of each of the foregoing items are difficult to obtain, because many of the items are not costed separately. For example, the purchase price of a lift often includes the cost of installation and one or two wheelchair securement devices. Transit operators also usually purchase a

package of modifications to the interiors of the buses (15).

Table 42 gives the reported capital cost of lifts and internal modifications of buses at six transit properties monitored for UMTA by the Transportation Systems Center (TSC). It reveals a considerable amount of variation in the unit cost of lifts. Part of this variation is because the purchase price of a lift may include other items such as one or more wheelchair securement devices, seat belts, and warning lights. The type of lift also influences the cost. Wheelchair lifts differ in the number and types of handrails, grab bars, and other security devices located either on the lift platform or in the stairwell of the bus. Retrofitting also tends to raise the unit capital cost of wheelchair lifts.

Table 42. Reported capital costs of lifts and internal modifications of buses at six locations monitored by the Transportation Systems Center.

	Cost per Bus	Number Purchased	Total Cost
Champaign-Urbana:			
EEC retrofit (1979)	$23,477	15	$352,155
EEC ADB (1979)	15,000	25	375,000
			$727,115
Connecticut Transit:			
EEC ADB (1978)	$ 8,000	280	$2,240,000
Palm Beach County:			
TDT retrofit (1978)			
lifts	$14,272	22	$313,984
jump seats	1,370	22	30,140
TMC (1979)	9,000	40	360,000
			$704,124
St. Louis:			
TDT (1976)	$ 5,000	60	$300,000
TDT (1977)	6,315	97	612,555
			$912,555
Seattle:			
Lift-U (1979)	$ 5,700	143	$815,100
Washington, D.C.:			
Vapor (1978)			
lifts	$ 6,618	150	$992,700
kneelers	350	150	52,500
other features	4,000	150	600,000
			$1,645,200

SOURCE: Ref. 36.

The costs given in Table 42 are for lift equipment ordered in 1978 and 1979. More recent information on the unit cost of wheelchair lifts was obtained through telephone calls to lift manufacturers. These data are given in Table 43. The responses of the manufacturers indicate that wheelchair lifts are now much more competitively priced.

Table 43. Unit cost of lift equipment in 1982.

Equipment		Cost
Manufacturer:	General Motors	$10,000
	Grumman Flxible	13,000
Retrofit:	EEC retrofit	$12,000
	TDT retrofit	10,000
	Lift-U	11,500

SOURCE: Lift manufacturers.

Because wheelchair lifts have long service lives, their costs can be annualized. TSC has assumed a service life of 10 years, a discount rate of 10 percent, and no salvage value (36). Based on these assumptions, the annual cost of wheelchair lifts in 1982 ranged from $1,000 to $1,300 per vehicle.

Wheelchair lifts and related accessories are generally the most costly capital items on an accessible bus. NYSDOT estimated that the cost of a kneeling device was about $800 per bus (25). As Table 42 shows, WMATA in Washington, D.C., paid $350 per bus for kneeling devices and $4,000 per bus for various other accessibility features. NYSDOT also estimated that the cost of reserved seating was about $50 per bus, the cost of extra handrails was approximately $200 per vehicle, and the cost of lower signal cords was also around $200 per vehicle (25). The cost of a TTY machine depends on the type of unit. Sun Tran in Tucson, Arizona, recently purchased a small portable unit for approximately $500. The Milwaukee County Transit System purchased a larger model with a CRT screen for $974.

The provision of accessible fixed-route bus service may require some renovation or modification of existing transit facilities. Bus stops, bus shelters, park-and-ride lots, terminals, and transit information centers may have to be altered or renovated to remove barriers. Maintenance facilities and storage areas may have to be modified to accommodate the testing, inspection, and repair of the wheelchair lifts. The costs of such renovations are liable to vary widely between transit systems, depending on local conditions. The renovation costs incurred to date by transit operators that are providing accessible fixed-route bus service have not been reported in the literature. Transit operators will have to make an inventory of their own facilities, identify any barriers, and prepare a capital improvement budget covering the cost of necessary renovations.

Planning and Monitoring Costs

A considerable amount of staff time may be required before the start of accessible fixed-route bus service for planning, scheduling, marketing, promoting, and implementing the service. Detailed analyses of administrative staff time and cost by type of activity are generally not available. The Bi-State Development Agency (BSDA) expended $14,040 worth of administrative staff time before the start of accessible bus service in St. Louis (36). Preimplementation administrative staff cost in Palm Beach County, Florida, amounted to $51,260 (36).

After the start of accessible bus service, some staff time will be needed to monitor handicapped person ridership and the performance of the lifts, to market and promote the service, to determine the impact of the service on bus schedules, to adjust the schedules if necessary, to assess the practicability of various operating procedures and policies and to ensure that they are being followed, and to plan further improvements or extensions in the service. BSDA in St. Louis spent approximately $68,180 in staffing costs during the first 12½ months of accessible bus service (36). Seattle Metro estimated that it spent $75,000 on staff time during its first year of accessible bus operations. These expenditures were expected to decrease to about $45,000 annually (15). In general, transit operators have assigned the equivalent of one or more full-time persons to the function of continually planning and monitoring the accessible fixed-route bus service (36).

Personnel Training Costs

The costs of training the drivers, mechanics, and other transit personnel are incurred both before and after the start of accessible bus service. Initial training costs are generally much higher. Table 44 gives the preimplementation cost of driver training at several transit properties. The cost ranged from $15 to $175 per driver (36). TSC estimated that the cost of a 4-hour training course, including the cost of instructors, would be between $55 to $66 per driver at a cost of $11 per driver-hour for salary, fringe benefits, and overhead (36). The costs of training mechanics before the start of accessible bus service have not been disseminated, except for St. Louis. BSDA spent an estimated $31,010, but this figure includes not only the cost of training the mechanics but also the cost of inspecting and preparing the lifts (36).

Table 44. Driver training costs before the start of accessible fixed-route bus service at four locations monitored by the Transportation Systems Center.

	Hours of Instruction per Driver	Total Cost of Driver Training
St. Louis	1	$16,322
Palm Beach County, Florida	5	13,500
Connecticut Transit	4	44,640
Washington, D.C.	3.5	144,000

SOURCE: Ref. 36.

After the accessible bus service has been implemented, there will usually be a need for a continual program of initial training for new drivers and mechanics and refresher courses for previously trained drivers. Connecticut Transit's annual cost of driver training in 1980 was approximately $34,800, including $5,040 for instructing new drivers and $29,760 for testing and retraining other drivers (36). This was about $10,000 below the preimplementation training cost. Seattle Metro expended approximately $35,000 on driver training during its first year of operation of accessible bus service, but expected to spend only $10,000 annually in subsequent years (15).

Maintenance and Inspection Costs

Table 45 summarizes the costs incurred by several transit operators for inspecting, maintaining, and repairing their wheelchair lifts. Lift maintenance costs have varied over a wide range for several reasons, including the reliability of the lifts and the maintenance policies, procedures, capabilities, and work-loads of individual transit operators. BSDA in St. Louis and San Diego Transit, for example, had considerable difficulty breaking in their retrofitted lifts (15,36).

Several transit operators have either increased the size of their maintenance staffs or designated one or more mechanics to handle the lift equipment. The Milwaukee County Transit System, for example, originally hired five additional mechanics to work exclusively on maintaining the wheelchair lifts. The costs of these mechanics' salaries and fringe benefits was estimated to be $120,000 per year (16). Table 46 shows the number of mechanics working full time on lifts at other transit properties.

Table 45. Lift maintenance and inspection costs of individual accessible fixed-route bus systems.

System	Annual Maintenance Cost per Lift
Champaign-Urbana, Illinois (36)	$ 669
Connecticut Transit (36)	552
Palm Beach County, Florida (36)	840
St. Louis (36)	
8/77-8/78	2,016
9/78-6/79	2,268
Seattle (36)	427
Detroit (15)	162
Los Angeles (15)	
200 lift-equipped buses	6,100
1,370 lift-equipped buses	4,015
San Diego (46)	4,200
Denver (46)	260

SOURCE: References indicated by the underlined numbers in parentheses.

Table 46. Number of mechanics working full time on lift maintenance and inspection at several transit properties.

System	Number of Mechanics Assigned to Lifts	Number of Buses per Lift Mechanic
Champaign-Urbana (Illinois) Mass Transit District	1	40
Connecticut Transit	2[a]	140
Detroit Department of Transportation	9	18
Los Angeles SCRTD	16	27
Milwaukee County Transit System	12	20
Palm Beach County (Florida) Transportation Authority	1[a]	63
Santa Monica (California)	1	47
St. Louis BSDA	8[a]	20
Washington, D.C., WMATA	9	17

[a]Equivalent

SOURCE: Ref. 47.

Costs of Additional Scheduled Service

Most of the transit operators that provide accessible fixed-route bus service have not had to make extensive and costly changes in their schedules or add extra vehicle-hours of service. One notable exception was the transit system in St. Louis. BSDA expected that the accessible bus service would greatly increase run times because of longer dwell times at bus stops while loading and unloading wheelchair users. Consequently, the agency added an average of 12 minutes layover time to each route. As a result, 24,435 extra platform hours of service were added over the first 12½ months of accessible service. This additional service cost BSDA $349,766 between August 1977 and June 1979. The extra service proved to be unnecessary, although it was retained. The actual total delay time during the first 12½ months was

only an estimated 509 hours (16). Connecticut Transit also made some scheduling and service changes in anticipation of adverse effects on schedule adherence and seating capacity. Layover times were increased on routes where current layover times were less than 5 minutes. Extra buses were added on heavily patronized routes to maintain seating capacity. The cost of these service modifications, however, were never quantified. Connecticut Transit eventually eliminated the extra layover times when they proved to be unnecessary (36). Thus far, accessible fixed-route bus services have not caused any serious problems with schedule adherence or delays, except during infrequent road calls due to lift failures. Consequently, transit operators have not had to make any major changes in their bus services (15,36).

Marketing and Promotion Costs

Most of the costs of marketing and promoting accessible fixed-route bus service are incurred before the service is implemented. Actual costs for individual systems have ranged from $15 to $89 per lift-equipped bus, reflecting the widely different marketing and promotional campaigns that have been undertaken (47). BSDA expended approximately $35,200 on marketing and publicizing the accessible bus service in St. Louis before Phase I of the service went into operation. BSDA's marketing program included demonstrations of the wheelchair lifts, radio commercials, television and newspaper advertisements, pamphlets, and a telephone information service (16). Connecticut Transit spent about $20,000, primarily on newspaper ads (36). The Milwaukee County Transit System spent $4,000 for approximately 125 radio announcements and $2,600 for newspaper advertisements (16).

Initial marketing and promotional efforts have sometimes extended into the first few months of operation of accessible bus service. Thereafter, they are generally reduced in scale. BSDA spent approximately $9,800 for radio commercials in 1978 and the first 6 months of 1979. Connecticut Transit's marketing expenditures during its first year of accessible bus service consisted of $8,000 for advertising on radio, $4,500 for booklets, and $2,600 for demonstrations of the lifts. Of this total of $15,100, approximately $10,600 were spent in the second and third months of accessible service (36). Seattle Metro expended an estimated $15,000 on marketing during its first year of accessible service. The projected annual marketing cost for the expanded system, however, was only $4,000 (15).

Insurance and Accident Claims Costs

Accessible fixed-route bus services generally have not increased insurance premiums because many transit operators are at least partly self-insured. One exception is Connecticut Transit, which has insurance with a private company for damage to its own property. The wheelchair lifts increased the premium for this insurance by $515 per year (36). According to one insurance company contacted during the project, the incremental cost of insurance could be as high as $100 per lift-equipped bus. A more likely value is $25.

Accidents involving wheelchair lifts have occurred at several properties including BSDA in St. Louis, Connecticut Transit, and Westchester County, New York. Instances of wheelchair users falling off the lifts have occurred at a rate of about one for every 400 to 600 attempted lift boardings, as of early 1981 (47). A majority of the accidents so far have involved ambulatory persons rather than wheelchair users. Because the step riser height on lift-equipped buses is often different from that on other buses, a number of incidents have occurred involving minor injuries to persons who tripped while boarding or leaving a bus. BSDA in St. Louis reported 51 incidents during the first 22½ months of accessible bus service, only four of which involved wheelchair users. Connecticut Transit experienced 37 incidents in its first 8 months of accessible bus service, none of which involved a wheelchair user. Only six accidents involving wheelchair users occurred at Connecticut Transit during the first 15 months of lift-equipped bus operations, representing a rate of about one occurrence for every 442 lift users. BSDA paid an average of $1,120 per claim for the four accidents involving wheelchair users. Settlement payments for claims made by ambulatory persons averaged $185 in Phases I and II and $435 in Phase III. Overall, accidents related to the accessible bus service cost BSDA approximately $412 per claim. Only three of the six wheelchair user accidents on Connecticut Transit's lift-equipped buses resulted in claims as of early 1981. Two were settled for a total payment of $397. The other claim, for $20,000, was still being contested in court (36).

Total Operating Costs

Table 47 contains some estimates of the total annual operating cost of accessible fixed-route bus service for six transit properties. It also indicates the effect that accesssible bus services have had on the total operating cost of the transit systems. The average annual operating cost for the three systems that included capital depreciation in their cost estimates was approximately $2,000 per lift-equipped bus. The average operating cost for the other three systems was also approximately $2,000 per year per bus, but as Table 47 shows, the variation was quite large. In general, accessible fixed-route bus services have increased total bus operating costs by a relatively small amount compared to recent increases in transit wages, the cost of parts and supplies, fuel prices, and inflation in general.

Table 47. Annual operating cost of accessible fixed-route bus service and effect on bus operating costs at several transit properties.

System	Annual Operating Cost per Lift-Equipped Bus	Percent Increase in total Bus Operating Costs
Connecticut Transit	$1,927[a]	N.A.
Detroit SEMTA	480	N.A.
St. Louis BSDA	1,804[a,b]	1.0
Seattle Metro	2,210[a]	0.39
Milwaukee County Transit	2,100	N.A.
San Diego Transit	4,200	4.9

[a]Includes capital depreciation.

[b]Out-of-pocket costs only.

SOURCE: Ref. 15.

Specialized Transportation Services

Because specialized transportation services can be provided in many ways, the cost of a vehicle-hour or vehicle-mile of service can vary consider-

ably. The literature cites examples of specialized transportation services with unit costs ranging from $2.59 to $23.67 per vehicle-hour and from $0.22 to $2.13 per vehicle-mile (33,41,48,49, 50,51). Among the factors that contribute to this wide range are differences in the types and mix of vehicles used, wage rates, and the organizational arrangements for managing and operating the services.

Unfortunately, the cost data reported in the literature for individual systems are generally not very useful for purposes of comparing and estimating the costs of alternative specialized transportation services. The data cover much of the 1970s and early 1980s, during which time gasoline and diesel fuel costs increased 146 percent, the cost of most vehicles increased at a higher rate than the cost of living index, and drivers' wages in the transit industry rose more rapidly than the wages of workers in many other sectors of the economy. In some cases, the data denote the costs of systems during their first year in operation, while in other cases, the data reflect the costs of systems that had been in operation for a number of years and therefore may have become more efficient and productive. Many systems serve elderly persons and sometimes other transportation disadvantaged people in addition to handicapped people. In such cases, it is usually impossible to determine from the literature the cost of transporting only the handicapped people. Some of the reported costs were developed from financial records and accounting data, while others were simply estimated or synthesized. Most importantly, the cost data in the literature are often incomplete and insufficiently detailed. Certain categories of cost are often excluded. Chief among these are depreciation, the cost of services provided by volunteers, and certain administrative costs including the costs of planning, marketing, and monitoring the services. Administrative costs and other indirect costs are sometimes excluded when the lead agency and the operating agency are different entities, when the service is provided by a social service agency, or when the service is provided by a public transit agency that also operates a regular fixed-route transit service. In the latter two cases, administration of the specialized transportation system is often combined with the administration of the regular transit system or the other social services offered by the agency. For these reasons, it is difficult to specify the total unit cost of providing specialized transportation services solely from the overall unit cost data reported in the literature for individual systems.

The cost of providing a vehicle-hour of specialized transportation service can be divided into three categories: capital costs of vehicles and equipment, direct operating costs, and indirect costs. Tables 48, 49, and 50 give the expected ranges of these costs as well as typical costs in each of these categories for systems consisting of vans without lifts, vans with lifts, and small buses with lifts, respectively. These tables do not represent the costs of any actual specialized transportation systems. They are intended to show the various components of the total cost, the expected range in the magnitude of cost for each component, and the contribution of each component toward the total cost of providing a specialized transportation service. An explanation of the numbers in these tables is provided in the following by cost category.

Capital Costs

Because of the variety of models and options available, vehicle and equipment costs can vary

Table 48. Cost of providing a specialized transportation service utilizing vans without lifts.

Cost Category	Low	Typical	High
Vehicle and equipment costs			
• Annualized cost	$3,760	$ 3,950	$ 4,150
• Average cost per vehicle-hour	$0.904	$ 0.950	$ 0.998
Direct operating costs (nonlabor)			
• Annual cost per vehicle			
• Fuel	$4,360	$ 4,800	$ 5,335
• Tires	480	600	680
• Oil, lubricants, and supplies	300	350	400
• Maintenance	500	600	700
• Insurance	600	710	1,200
Total	$6,240	$ 7,060	$ 8,315
• Average cost per vehicle-hour	$1.500	$1.697	$ 1.999
Direct operating cost (labor)			
• Average cost per vehicle-hour	$ 4.00	$ 6.00	$ 11.00
Indirect costs			
• Percent of total direct operating cost	25	40	50
• Average cost per vehicle-hour	$1.375	$ 3.079	$ 6.500
Total cost per vehicle-hour	$7.779	$11.726	$20.497

Table 49. Cost of providing a specialized transportation service utilizing lift-equipped vans.

Cost Category	Low	Typical	High
Vehicle and equipment costs			
• Annualized cost	$3,960	$ 4,160	$ 4,370
• Average cost per vehicle-hour	$0.952	$ 1.000	$ 1.050
Direct operating costs (nonlabor)			
• Annual cost per vehicle			
• Fuel	$4,360	$ 4,800	$ 5,335
• Tires	480	600	680
• Oil, lubricants, and supplies	300	350	400
• Maintenance	600	700	800
• Insurance	600	750	1,200
Total	$6,340	$ 7,200	$ 8,415
• Average cost per vehicle-hour	$1.524	$1.731	$ 2.023
Direct operating cost (labor)			
• Average cost per vehicle-hour	$ 4.00	$ 6.00	$ 11.00
Indirect costs			
• Percent of total Direct operating cost	25	40	50
• Average cost per vehicle-hour	$1.381	$ 3.092	$ 6.512
Total cost per vehicle-hour	$7.857	$11.823	$20.585

Table 50. Cost of providing a specialized transportation service utilizing small lift-equipped buses.

Cost Category	Low	Typical	High
Vehicle and equipment costs			
• Annualized cost	$4,305	$ 4,520	$ 4,745
• Average cost per vehicle-hour	$1.035	$ 1.087	$ 1.141
Direct operating costs (nonlabor)			
• Annual cost per vehicle			
• Fuel	$5,650	$ 6,400	$ 6,860
• Tires	700	800	900
• Oil, lubricants, and supplies	500	550	600
• Maintenance	1,000	1,300	1,500
• Insurance	1,000	1,250	1,800
Total	$8,850	$10,300	$11,660
• Average cost per vehicle-hour	$2.127	$2.476	$ 2.803
Direct operating cost (labor)			
• Average cost per vehicle-hour	$ 5.00	$ 6.00	$ 12.00
Indirect costs			
• Percent of total Direct operating cost	25%	40%	50%
• Average cost per vehicle-hour	$1.782	$ 3.390	$ 7.402
Total cost per vehicle-hour	$9.944	$12.953	$23.346

considerably. Available published data on existing specialized transportation services do not specify the vehicles used in enough detail to determine vehicle and equipment costs. Therefore, bid specifications were developed for the following two vehicles:

- Van--12-passenger van with heavy duty suspension, power brakes and power steering, air conditioning outlets front and rear, automatic transmission, and V-8 engine.
- Bus--21-passenger bus (or seating for 17 passengers and 2 wheelchair users) with a 10,000 to 12,000 GVW truck unit of 176-inch or greater nominal wheelbase, dual rear wheels, 400 CID or greater V-8 engine, power brakes and power steering, automatic transmission, air conditioning outlets front and rear, and auxiliary heating in the rear.

Bids for these two types of vehicles were requested from bus and van manufacturers and dealers. The average purchase price was $11,600 for the van and $24,100 for the small bus. Bids were also solicited from manufacturers of wheelchair lifts and dealers of radio communications equipment. The average additional cost of a lift-equipped van or small bus was $2,500. To these costs was added $900 for a mobile two-way radio. These costs were then annualized. The annualized cost of the van was based on a 3-year life, a resale value of $3,355, and a 10 percent discount rate. The annualized cost of the small bus was based on a service life of 5 years, a resale value of $5,000, and a 10 percent discount rate. To determine the capital cost per vehicle-hour, it was assumed that each vehicle would be operated 80 hours a week or 4,160 hours a year (52,53). A comparison of Tables 48 and 49 shows that the addition of wheelchair lifts on the vans increases the capital cost per vehicle-hour by approximately 5 percent. The capital cost per vehicle-hour of small lift-equipped buses is about 8.7 percent higher than that of lift-equipped vans.

Direct Operating Costs

Direct operating expenses are generally related to the amount of service provided. They normally increase as the number of vehicle-hours of service increase although usually not in a simple direct proportion. They include the costs of drivers, fuel, oil and lubricants, parts and supplies, tires, maintenance labor, and insurance.

Professional drivers' wages vary from minimum wage or slightly higher for drivers employed by some social service agencies to $10 or more per hour for unionized drivers employed by public transit agencies. The high rate of $11 per hour in Tables 48 and 49 reflects the average wages of drivers for transit properties managed by the ATE Management and Service Co., Inc. as reported to the Knoxville Transportation Authority. A high rate of $12 per hour was used in Table 50, because drivers of small buses tend to earn more than drivers of vans. The typical rate of $6 per hour is the average hourly wage of local bus drivers nationwide, according to the 1981 occupational survey of the U.S. Bureau of Labor Statistics. The low rate of $4.00 per hour is the minimum wage of $3.85 rounded up. Again, a higher low wage rate was used for drivers of small buses than for drivers of vans.

The range in the annual cost of fuel per vehicle is due primarily to variations in fuel efficiency. Forty agencies that operate fleets of vans were contacted. The average rate of fuel consumption for their fleets ranged between 9 and 11 miles per gallon. The overall weighted average for the sample was 10 miles per gallon. There were insufficient data to compare the fuel efficiency of vans with lifts to the fuel efficiency of vans without lifts; consequently, the same range in fuel consumption rates was used in each case. The fuel consumption rates for small buses were based on information obtained in phone conversations with seven specialized transportation services that operate such vehicles. These rates ranged between 7.0 miles per gallon for The Lift in Knoxville and 8.5 miles per gallon for Metrolift in Houston. The weighted average fuel consumption rate was 7.5 miles per gallon. The annual cost of fuel was based on the assumption that a vehicle would be driven approximately 40,000 miles a year (52). The price of fuel was assumed to be $1.20 per gallon.

Data from the National Association of Van Pool Operators indicate that the cost of lubrication, oil, and supplies ranges between 0.75 and 0.99 cents per mile for vans and between 1.25 and 1.5 cents per mile for small buses. The midpoint of each of these ranges was used to compute the typical annual costs for these items.

According to a recent study by an equipment manufacturer, tire costs for vans vary from 1.2 to 1.7 cents per mile (54). The typical tire cost for vans is 1.5 cents per mile. Tire costs for small buses are slightly higher, ranging from 1.75 to 2.25 cents per mile.

The annual maintenance costs for specialized transportation services that utilize vans were based on information obtained in phone conversations with 40 van fleet operators. The data are presented in Table 51. Conversations with lift manufacturers, van fleet operators, and mechanical engineers at The University of Tennessee led to the conclusion that the additional annual maintenance cost of a lift-equipped van is likely to be around $100.

Data on the annual maintenance costs of lift-equipped small buses are much more limited. The Knoxville Transportation Authority in a telephone interview, indicated that it spends approximately

Table 51. Annual maintenance cost per vehicle incurred by selected van fleet operators.

Van Fleet Operator	Numer of Vehicles	Annual Maintenance Cost per Vehicle ($)
St. Lawrence County (New York) Community Development Program	6	500
Rehabilitation and Training Developmental Enterprises (Michigan)	7	504
Berlin (New Hampshire) Community Action Committee	18	507
Cortland County (New York) Community Action Program	12	522
Montgomery County (Pennsylvania) Office on Older Adults	5	537
Madison County (Virginia) Office for Aging	5	540
Fayetteville (Arkansas) Resource Group, Inc.	17	540
Lansing (Michigan) Capital Area Transportation Authority	37	542
Eagleville (Pennsylvania) Hospital and Rehabilitation Center	4	579
The University of Tennessee Motor Pool (Tennessee)	38	587
Getty Oil Vanpool Program (Oklahoma)	130	589
Camden County (New Jersey) Senior Citizens Center	6	593
Commuter Transportation Services (California)	341	594
San Bernardino (California) Omnitrans	62	597
Cornell University (Ithaca, New York)	18	598
The Gray Line Tours Company (Nationwide)	347	600
Louden County (Virginia) Transportation Authority	7	601
South Bend (Indiana) Specialized Transportation System	30	602
Tennessee Valley Authority Vanpool Program (Tennessee)	276	602
Delaware Authority for Specialized Transportation	20	603
Southeast Idaho Council of Governments	137	603
Bucks County (Pennsylvania) Association for the Retarded	5	604
Delaware Valley Regional Transportation Authority	34	606
Knoxville (Tennessee) Community Action Committee	18	608
Tidewater Regional Transit Authority (Virginia)	48	620
Sun Co., Inc., Vanpool Program (Pennsylvania)	60	620
Chester County (Pennsylvania) Services for Senior Citizens	6	632
Norristown (Pennsylvania) Community Day Care Association	6	632
United Cerebral Palsy Association (Los Angeles County, California)	7	641
Northeastern Illinois Regional Transportation Authority	132	670
Onondaga County (New York) Office of Economic Development	6	672
Continental Limousine Service (Illinois)	37	674
Association for Retarded Citizens (Texas)	8	675
Wasatch Front Regional Council (Utah)	37	675
Kent State University Campus Transportation Service (Ohio)	14	682
Philadelphia Corporation for Aging (Pennsylvania)	6	690
Broome County (New York) Transit Service	8	695
Southeastern Pennsylvania Transportation Authority	27	698
Community Action Agency of Comumbiana County (Ohio)	8	700
Rochester-Genessee Regional Transit Authority (New York)	11	700
Weighted Average		608

SOURCE: Van fleet operators.

$1,200 per vehicle per year to maintain small lift-equipped buses that are one-year old. Several properties that operate both vans and minibuses indicated that the annual maintenance cost of the latter is about 10 percent higher excluding the lift. Thus, without the lifts, the annual maintenance cost of small buses can range between $550 and $770 per vehicle. Lift maintenance can add another $450 to $850 to the yearly maintenance cost of each vehicle (36).

Estimates of the annual insurance cost per vehicle were obtained from the Insurance Services Office in New York City. These costs are influenced by many factors including state laws and regulations, the classification of the carrier, and the size or seating capacity of the vehicles.

Indirect Operating Costs

These costs are often the most difficult to isolate. They include the costs of planning, marketing, monitoring, and administering a specialized transportation service as well as the costs of fixed facilities, rent, utilities, office supplies, communications, postage, and fringe benefits. Although the magnitude of these costs depends on the size of the system, most of them do not change with small changes in the number of vehicle-hours of service provided. Some of these costs are incurred only once or occasionally, while others arise continually. For example, most of the planning costs are incurred before the service is implemented, while monitoring costs are incurred either continually or intermittently after the service begins.

To gauge the potential range of indirect costs, the operating statements of a number of transit properties and specialized transportation services were examined. Table 52 shows the indirect cost as a percentage of the total direct operating cost for each system examined. The upper bound of the range was established by transit properties in urban areas with a population over one million. Indirect costs for these properties ranged between 41 and 59 percent of the total direct costs. The average was approximately 50 percent. Transit properties in smaller cities down to 100,000 population had indirect costs ranging between 33 and 47 percent of the total direct cost. The average for this group was about 40 percent. Specialized transportation services operated by social service agencies determined the lower bound of the range

Table 52. Indirect cost of public transportation systems.

System	Indirect Cost as a Percent of Total Direct Cost
Systems Operating in Urban Areas of Over 1 Million Population	
Chicago Transit Authority	59.1
New York City Transit Authority	58.7
New Jersey Transit Corporation	56.4
Washington, D.C., Metropolitan Area Transit Authority	54.2
Niagara Frontier Transportation Authority (Buffalo, New York)	53.7
Metropolitan Transit Authority of Harris County (Houston, Texas)	53.3
Greater Cleveland Regional Transit Authority	51.7
Port Authority of Alleghany County (Pittsburgh, Pennsylvania)	50.3
Massachusetts Bay Transportation Authority (Boston, Massachusetts)	50.1
Metropolitan Dade County Transit Agency (Miami, Florida)	50.0
Southeastern Pennsylvania Transportation Authority (Philadelphia)	49.9
Alameda-Contra Costa Transit District (Oakland, California)	49.5
Queen City Metro (Cincinnati, Ohio)	49.3
Milwaukee Transport Services, Inc.	49.1
Denver Regional Transportation District	49.1
Southeastern Michigan Transportation Authority (Detroit)	48.7
Baltimore Metropolitan Transit System Division	48.5
Dallas Transit System	48.4
Metropolitan Transit Commission (Minneapolis-St. Paul, Minnesota)	47.7
San Diego Transit Corporation	47.3
Santa Clara County Transportation Agency (San Jose, California)	47.1
Kansas City Area Transportation Authority	46.7
Metropolitan Atlanta Rapid Transit Authority	44.8
Orange County Transit District (California)	41.2
Average	50.2
Systems Operating in Urban Areas Between 100,000 and 1 Million Population	
New Orleans Regional Transit Authority	46.7
Tri-County Metropolitan District of Oregon (Portland)	44.3
Providence Public Transit Authority (Rhode Island)	44.3
Phoenix Transit Administration	43.7
Toledo Area Regional Transit Authority	43.7
Central New York Centro, Inc. (Syracuse)	42.1
Pierce County PBTA (Tacoma, Washington)	42.1
VIA Metropolitan Transit (San Antonio, Texas)	41.3
Rochester-Genessee Regional Transit Authority	41.3
Hartford Transit District (Connecticut)	41.3
Washington Transit Management, Inc. (Spokane, Washington)	41.3
City of Omaha Transit Authority	40.1
Columbus Transit Authority (Ohio)	40.0
Greater Richmond Transit Company (Virginia)	39.9
Transit Authority of River City (Louisville, Kentucky)	39.7
Sacramento Regional Transit District (California)	39.4
Transit Management of Tucson (Arizona)	39.1
Broward County Division of Mass Transit (Ft. Lauderdale, Florida)	37.6
Utah Transit Authority (Salt Lake City)	37.6
Miami Valley Regional Transit Authority (Dayton, Ohio)	37.4
Nashville Metropolitan Transit Authority	37.4
Indianapolis Public Transit Corporation	36.9
Tidewater Transportation District Commission (Norfolk, Virginia)	36.8
Memphis Area Transit Authority	36.4
San Juan Metropolitan Bus Authority	34.4
Jacksonville Coach Company	34.2
Knoxville Transportation Authority	33.0
Average	39.7
Systems Operated by Social Service Agencies	
United Cerebral Palsy Association (Los Angeles County, California)	37.6
Bucks County (Pennsylvania) Association for Retarded	34.3
Chester County (Pennsylvania) Services for Seniors	27.3
Phoenix (Arizona) Red Cross	27.0
Madison County (Virginia) Office for Aging	26.4
Senior Citizens Pomona Valley (California)	25.3
Community Action Committee of Knoxville (Tennessee)	24.4
Fairfield (Connecticut) Department of Aging	24.3
Columbiana County (Ohio) Community Action Agency	21.3
Spokane (Washington) YMCA Motor Pool	18.7
Amarillo (Texas) Community Action Committee	18.4
Camden County (New Jersey) Senior Center	18.3
Berlin (New Hampshire) Community Action Committee	17.0
Average	24.6

SOURCE: Operating statements of public transportation systems.

of indirect costs. Their indirect costs varied between 17 and 38 percent of their total direct costs and averaged around 25 percent. The three averages of 25, 40, and 50 percent were taken as the low, typical, and high estimates of the indirect operating costs of specialized transportation services.

Total Cost

The component cost analysis presented in Tables 48 through 50 indicates that the total cost of a specialized transportation service can vary between $7.78 and $23.35 per vehicle-hour. The lower value is indicative of a service operated by a social service agency or a private nonprofit organization with drivers paid slightly more than the minimum wage and vans not equipped with wheelchair lifts. The higher value is more indicative of a service operated by a public transit authority in a large metropolitan area with unionized drivers and small buses with lifts. The above range in total costs corresponds closely with the range in unit costs of specialized transportation services cited in the literature. A few specialized transportation services have reported costs well below $7.78 per vehicle-hour. These systems, however, often use either volunteers or social workers as drivers. Moreover, they often do not include vehicle depreciation and certain overhead and administrative costs in their total cost calculations.

Taxicab User-Side Subsidy Programs

The public cost of a user-side subsidy program can be divided into two components: subsidy payments and administrative costs. The administrative costs in turn can be divided into initial planning and implementation costs, incurred before the program starts, and operating costs, incurred after the program begins.

Subsidy Costs

The amount paid annually to participating taxi operators to subsidize the travel of eligible riders depends on many factors. Obviously, the larger the number of subsidized trips made, the greater will be the total subsidy payment. By limiting the demand, the annual subsidy can be controlled or brought into line with available finances. The demand can be managed by placing tighter restrictions on eligibility, limiting the number of subsidized trips an eligible individual is allowed to make over a certain period, or placing restrictions on the types of trips eligible for the subsidy. Subsidy payments also depend on the size of the regular taxi fares and the size of the discount. The difference between the two is the subsidy per trip. This can be controlled by imposing a maximum subsidy per trip or by requiring the subsidized user to pay a higher portion of the fare. The size of the service area can also have an effect on the total subsidy. As the service area increases, the average trip length tends to increase as well. Because taxi fare schedules are normally based on distance traveled, the average cost of a taxi trip will also tend to rise as the service area increases.

The combined effect of these various factors can be seen in Table 53, which compares the annual subsidy payments and the average subsidy per trip for a number of user-side subsidy programs. Annual subsidy costs have ranged from about $3,600 in Lafayette, California, to over $900,000 in Milwaukee County. The average subsidy per trip has varied from $0.63 to $6.71. The programs with the lowest average subsidies per trip generally covered relatively small service areas, while those with the highest average subsidies per trip usually served entire counties.

Administrative Costs

The four major areas of administrative or operating cost in a user-side subsidy program consist of personnel and fringe benefits, office rental and supplies, promotion and advertising, and computer processing. Table 54 indicates the magnitude of these costs for four Service and Management Demonstration (SMD)-monitored programs. The figures in this table represent the average monthly costs of operating the user-side subsidy programs. They do not include the costs of initial planning and implementation.

The largest component of cost in each case was labor. However, the portion of the total cost attributable to personnel and fringe benefits varied considerably between the four programs. In Danville, the total labor cost accounted for slightly more than a third of the total administrative cost. In Montgomery, 55 percent of the total administrative cost was due to labor. In Lawrence and Kinston, the portion attributable to labor was 84 percent and 89 percent, respectively. There are several reasons for this wide variation. Two of the primary factors are the size of the staff and the amount of staff time devoted to administering the program. Labor costs were much lower in Danville because the program required the equivalent of only 0.55 full-time positions, compared to 2.18 in Kinston, 2.20 in Lawrence, and 2.65 in Montgomery. In addition, only 88 staff hours a month were needed to operate the program in Danville, compared to 350 in Lawrence, 367 in Kinston, and 404 in Montgomery. Another major factor affecting the magnitude of the labor cost is the use of computers for processing vouchers. The program in Danville made extensive use of computers for this purpose. This explains the small staff size and low number of staff hours required to operate that program. The Montgomery user-side subsidy program eventually converted from manual to computerized processing. As a result, the staff was reduced from 3.60 equivalent full-time positions to 2.65. Differences in wage rates also accounted for some of the variation in the labor costs of the four programs. The average hourly wage rates were $3.81 in Kinston, $5.01 in Montgomery, $5.40 in Danville, and $7.38 in Lawrence (36).

Total administrative costs are not very dependent on the number of trips subsidized by a user-side subsidy program. The Danville program, for example, subsidized an average of 7,500 trips a month in 1979, while the Montgomery program subsidized 3,016 trips. However, as Table 54 shows, the Danville program had the lowest total monthly administrative cost and the Montgomery program the highest among the four SMD-monitored projects. The Lawrence program handled 8,080 trips in an average month, only slightly more than the volume in Danville. Nevertheless, the average monthly administrative costs were over 2½ times larger in Lawrence than in Danville. In Kinston, an average of 3,070 trips were subsidized per month, only slightly more than the 3,016 trips per month in Montgomery. Yet, the Kinston program's total administrative costs were 60 percent lower than the Montgomery program's (36). Differences in the total administrative costs of the four user-side subsidy programs were primarily due to differences in labor costs and office rental rather than to differences in the volumes of subsidized trips.

Table 53. Annual subsidy payments and average subsidy per trip for several user-side subsidy programs.

Location	Service Area (Sq. Mi.)	Cost to User	Monthly Travel Limit	Annual Subsidy Payment	Average Subsidy per Trip
Lafayette, Calif. 1977 (37)	13	45% of meter fare	None	$ 3,590	$ 0.63
Lawrence, Mass. 1979 (36)	7	50% of zone fare	$20[a]	73,654	0.76
Kinston, N.C. 1979 (36)	6	50% of zone fare	$25[a]	30,731	0.83
Danville, Il. 1976 (36)	13	50% of zone fare	$20[a]	91,715	1.02
Montgomery, Ala. 1979 (36)	46	50% of zone fare	$30[a]	52,403	1.45
Kansas City, Mo. 5/77-4/78 (36)	314	50¢[b]	25 trips	89,359	1.58
San Leandro, Calif. 1977 (37)	15	50¢	10 trips	12,995	1.70
Fremont, Calif. 1977 (37)	95	50¢	16 trips	8,673	1.75
Los Angeles, Calif., Harbor Area 12/78-11/79 (36)	23	15¢[c]	20 trips	110,674	1.87
Palo Alto, Calif. 1977 (37)	26	10%, 30%, or 50% of meter fare[d]	$20[a]	$ 44,550	2.25
Sunnyvale, Calif. 1977 (37)	24	50¢	30 trips per quarter	N.A.	2.30
Santa Clara County, Calif. 1977 (37)	1,302	None	16 trips per year	22,540	3.24
Seattle, Wash. 1980 (38,55)	N.A.[e]	50% of meter fare	$2,000 per year[a]	149,000	3.34
Milwaukee County, Wis. 1980 (39,55)	N.A.	$1.50[f]	None	917,842	6.71

[a]Total undiscounted taxi fares.

[b]Users also pay the additional cost of trips over 4 miles long.

[c]Users also pay any amount over $3.00 on the taxi meter.

[d]The amount of the subsidy depends on the user's annual income.

[e]The program covers King County.

[f]Persons not in wheelchairs also pay any amount over $8.00 on the taxi meter; wheelchair users also pay any amount over $11.00 on the taxi meter.

SOURCE: References indicated by the underlined numbers in parentheses.

Table 54. Average monthly administrative costs four of four SMD-monitored user-side subsidy programs.

Cost Component	Danville, Ill. (1976)	Montgomery, Ala. (1979)	Kinston, N.C. (1979)	Lawrence, Mass (1979)
Direct labor costs	$ 475	$2,125	$1,400	$2,582
Overhead @ 25%	75	531	350	646
Total labor costs	$ 550	$2,656	$1,750	$3,228
Office rental and supplies	350	1,773	200	555
Promotion and advertising	100	83	10	63
Computer processing	500	325	-	-
Total administrative costs	$1,500	$4,837	$1,960	$3,846

SOURCE: Ref. 36.

Total Costs

Table 55 shows that subsidy costs usually comprise the bulk of the total cost of a user-side subsidy program. Subsidy payments in Milwaukee County, one of the largest programs, constituted 92 percent of the total annual costs. Milwaukee County also had the highest annual number of subsidized trips of the eight programs shown. This, combined with the high meter-based taxi fares and the lack of any limits on subsidized travel in Milwaukee County, accounts for the predominance of subsidy payments over administrative costs in that program. In Danville, Los Angeles, and Seattle, subsidy costs accounted for at least three-fourths of the total annual costs. Only in Montgomery did administrative costs dominate. This can be partially explained by the relatively high staff requirements and office rental costs experienced by that program. The Montgomery program also had the lowest annual number of subsidized trips of the eight programs shown in the table (55).

Table 55. Total annual cost of user-side subsidy programs.

Site of Program	Annual Subsidy Payments	Annual Administrative Cost	Total Annual Cost
Kinston, N.C. (1979)	$ 30,731	$ 23,520	$ 54,251
Danville, Ill. (1976)	91,715	18,000	109,715
Montgomery, Ala. (1979)	52,403	58,044	100,447
Lawrence, Mass. (1979)	73,654	46,116	119,770
Kansas City, Mo. (5/77-4/78)	89,359	48,120	137,479
Los Angeles, Calif., Harbor Area (12/78-11/79)	110,674	31,576	142,250
Seattle, Wash. (1980)	149,000	59,000	199,000
Milwaukee, Wis. (1980)	917,842	75,500	993,348

SOURCE: Ref. 55.

Planning and Implementation Costs

Before a user-side subsidy program can begin, a number of activities must be performed. Local private carriers must be surveyed, contacted, and enlisted into the program. Decisions must be made concerning eligibility for the program, the subsidy instrument, the fare discount, the maximum subsidy per trip, limits on subsidized travel, and eligible trips. Procedures must be established for screening and registering applicants, distributing tickets or scrip, verifying the participating carriers' claims for reimbursement, and redeeming the vouchers, tickets, or scrip. The program must be promoted and advertised, an operating budget has to be prepared, and financial support has to be garnered. Preimplementation activities can also include initial registration of potential users and development of computer software for accounting and voucher processing. Each of these activities incurs a cost, mostly for staff time.

Data on initial planning and implementation costs are available for only a few programs. In the Los Angeles harbor area, $5,000 was spent before the start of operations (42). Planning and implementation costs in Kinston amounted to about $11,000. Of this total, $4,680 was spent on project planning and initiation, $4,000 for office supplies and equipment, $1,475 for initial promotion and advertising, and $845 for initial registration (36). In Danville, approximately $14,000 was expended before the program began. The bulk of this amount was spent on project planning and initiation. Another $3,500 was spent on office supplies and equipment, $2,500 on software development, $1,500 for initial promotion and advertising, and $1,000 for the cost of initial registration (36).

Private Carrier Costs

User-side subsidy programs can impose additional administrative burdens on the participating private carriers. The extra workload primarily comes from having to prepare and submit claims for reimbursement. In some cases, the dispatchers may have to record additional information on subsidized trips. To handle these additional administrative tasks, the participating cab company in the Los Angeles harbor area program had to hire an extra order taker. This extra labor cost the cab company $6,400 in wages and $5,000 in additional overhead before the cost of the extra order taker was paid for out of the program's budget (42). Private carrier cost data from other programs, unfortunately, are not readily available. In general, it appears that the marginal cost of user-

side subsidy programs to the participating private carriers has been relatively small, given the popularity of these programs among many of the participants.

Taxi operators generally have not had to increase substantially the size of their fleets to accommodate the subsidized trips. Some small private carriers, however, have elected not to participate in user-side subsidy programs for fear they would not be able to handle both their regular riders and the subsidized riders with their current fleet of vehicles.

Mobility Training Programs

The cost of training a mentally retarded person to use a regular, fixed-route bus service has ranged from $280 per individual in a Los Angeles area program (56) to $1,800 per individual in a Wayne County, Michigan, program (57). The Mobility Training Program in Sacramento, California, costs $690 per individual (57). These unit costs cover not only the salaries and expenses of the instructors but also program accounting, marketing, and monitoring; program start-up; development of training manuals; client assessment; data collection; insurance; and bus passes used during the training period.

The bulk of the cost of a mobility training program is for administrative and overhead expenses. Of the $65,700 spent during the first year of the Mobility Training Program in Sacramento, only $12,872 was devoted to actual training. Another $3,000 was contributed by the transit operator in the form of bus passes for clients and instructors. The remaining $49,828 was charged to various administrative and overhead expenses. Start-up costs alone accounted for approximately 65 percent of the first year's total cost (57). Thus, in subsequent years, the cost per individual should decrease.

Because the curriculum of mobility training programs has generally been standardized, the primary determinant of cost is the way in which the program is implemented. For example, some of the overhead costs of the Mobility Training Program in Sacramento were overstated because the program was originally administered by the Sacramento Area Council of Governments. Some of the indirect costs allocated to the program were not actually incurred by the program. Although the administrative staff of the Council of Governments accounted for only 8 percent of the person-hours devoted to the program, they accounted for 36 percent of the costs. Consequently, when the program was shifted from the Council of Governments to a private, nonprofit provider of specialized transportation services, the cost of training each individual fell to $500 (57).

Start-up costs can be reduced by adopting a training manual from another program instead of developing a new one. The Sacramento program spent over $4,000 to develop its own manual (57).

Another way of reducing the training costs is to employ part-time paraprofessional instructors rather than full-time professionals. The Sacramento program, for example, hired college students. Other programs have had success with senior citizens as instructors. By using part-time paraprofessionals, a mobility training program can tailor the number of instructors to the number of availability of clients.

The cost of retraining mentally retarded persons is considerably less than the cost of the initial training. Retraining is usually necessary only when major changes are made in a bus route or when a mentally retarded person must learn a new route. Such training is usually much easier and, therefore, less expensive. In the Sacramento program, retraining required less than one-fourth the time needed for initial training (57).

EFFECTIVENESS OF THE ALTERNATIVES

Accessible Fixed-Route Bus Systems

Lift Use

One of the simplest measures of the effectiveness of accessible fixed-route bus services is the average number of handicapped passenger trips by bus per day. Unfortunately, this is not the easiest measure for which data are available. Transit operators generally have not made counts of all types of handicapped bus riders. The best information generally available consists of the number of lift boardings per day. Even these data, however, have some flaws and limitations. Some transit operators allow other transportation handicapped people besides wheelchair users to ride the lifts. Thus, the number of lift boardings per day does not always mean the number of wheelchair-bound bus passengers per day. Nevertheless, the ratio of the number of lift boardings per day to the number of lift-equipped buses in the fleet provides a useful statistic for comparing the relative effectiveness of various accessible fixed-route transit systems.

Table 56 presents statistics on the use of the lifts for a number of accessible fixed-route, fixed-schedule bus systems of all sizes throughout the country. In addition to the average number of lift boardings per day, two normalized indicators of lift use are shown. The first, lift boardings per day per lift-equipped bus, is based on the total number of lift-equipped buses in a system's fleet. Most of the larger transit properties, however, do not deploy all of their lift-equipped buses at the same time. A certain percentage are usually kept in reserve. The number of lift-equipped buses scheduled for service during the day is usually the same as the number in operation during the peak period. Thus, the second normalized indicator of lift use is based on the number of lift-equipped buses in service during the peak period. This is a better measure of the demand relative to the supply of accessible bus service. Unfortunately, this statistic could only be determined for a few of the systems shown in Table 56.

To date, lift use has been low at most sites. Only a few transit operators are transporting more than 10 lift users a day. None of the larger transit systems and only a few of the small properties are hauling one or more lift users per day per scheduled lift-equipped bus.

One notable exception to the common experience of low lift use is the Seattle Metro system. In late 1980, Seattle Metro had over three times as many lift boardings per day as any other accessible fixed-route bus system. In the 2-years since then, daily lift use has nearly doubled. Seattle Metro has one-fourth as many lift-equipped buses as the Southern California Rapid Transit District (SCRTD) in Los Angeles, but over eight times as many lift users per day.

Koffman (58) cites several possible explanations for Seattle's relative success with accessible fixed-route bus service. One of the more overriding factors is Seattle Metro's commitment to providing high quality, reliable service. As a result, the agency has maintained the lifts in reliable operating condition and thus avoided many of the problems with lift failures that other transit

Table 56. Utilization of lifts on accessible fixed-route bus systems.

Site	Date of Lift Usage Data	Buses	Lift-Equipped Buses	Peak Period Buses	Peak Period Lift-Equipped Buses	Lift Boardings Per Day	Lift Boardings per Day per Lift-Equipped Bus	Lift Boardings per Day per Peak Lift-Equipped Bus
Newport, Ore.[1]	Summer 82	2	2	1[a]	1	0.7	0.350	0.700
Red Wing, Minn.[1]	Summer 82	2	2	1[a]	1	2.0	1.000	2.000
Hutchinson, Minn.[1]	Summer 82	3	3	2[a]	2	0.1	0.033	0.050
Corvallis, Ore.[1]	Summer 82	3	3	2[a]	2	2.5	0.833	1.250
Jim Thorpe, Penn.[1]	Summer 82	4	2	N.A.	N.A.	0.0	0.000	0.000
Muscatine, Iowa[1]	Summer 82	4	2	4[a]	2	2.0	1.000	1.000
Frankfort, Ky[1]	Summer 82	4	3	N.A.	N.A.	0.0	0.000	0.000
Manitowoc, Wis.[1]	Summer 82	5	3	5[a]	3	0.0	0.000	0.000
Paducah, Ky.[1]	Summer 82	5	5	5[a]	5	2.0	0.400	0.400
Harrisonburg, Va.[1]	Summer 82	5	2	N.A.	N.A.	0.0	0.000	0.000
Moncks Corner, S.C.[1]	Summer 82	6	4	N.A.	N.A.	2.0	0.500	N.A.
Eureka, Calif.[1]	Summer 82	7	4	5[a]	4	1.0	0.250	0.250
Mt. Pleasant, Mich.[1]	Summer 82	7	6	6[a]	6	0.0	0.000	0.000
Zanesville, Ohio[1]	Summer 82	7	3	N.A.	N.A.	0.0	0.000	0.000
Fort Collins, Colo.[1]	Summer 82	8	2	6[a]	2	0.0	0.000	0.000
Medford, Ore.[1]	Summer 82	8	3	N.A.	N.A.	1.0	0.333	N.A.
Winona, Minn.[1]	Summer 82	9	2	N.A.	N.A.	1.0	0.500	N.A.
Clinton, Iowa[1]	Summer 82	10	2	N.A.	N.A.	0.0	0.000	0.000
Hot Springs, Ark.[1]	Summer 82	10	6	N.A.	N.A.	8.0	1.333	N.A.
S. Lake Tahoe, Nev.[1]	Summer 82	10	8	N.A.	N.A.	2.0	0.250	N.A.
Monroe, Mich.[1]	Summer 82	10	2	N.A.	N.A.	0.0	0.000	0.000
Canton, N.Y.[1]	Summer 82	11	1	N.A.	N.A.	8.0	8.000	N.A.
Quincy, Ill.[1]	Summer 82	11	8	N.A.	N.A.	0.0	0.000	0.000
Cumberland, Md.[1]	Summer 82	12	4	10[a]	4	0.5	0.125	0.125
Steamboat Springs, Colo.[1]	Summer 82	12	7	N.A.	N.A.	0.0	0.000	0.000
Johnson City, Tenn.[1]	Summer 82	12	3	8[a]	3	0.0	0.000	0.000
Janesville, Wis.[1]	Summer 82	22	10	N.A.	N.A.	2.0	0.200	N.A.
Stamford, Conn.[2]	Fall 80	36[b]	25	28	24	1.2	0.048	0.050
Chapel Hill, N.C.[1]	Summer 82	37	16	N.A.	N.A.	1.0	0.063	N.A.
Wichita, Kan.[2]	Fall 80	48[b]	31	46	31	2.0	0.065	0.065
Champaign-Urbana, Ill.[2]	Fall 80	66[b]	40	33	11	1.7	0.043	0.155
Palm Beach County, Fla.[2]	Fall 80	68[b]	67	50	50	3.9	0.058	0.078
Newport, Ky.[1]	Summer 82	91	10	N.A.	N.A.	0.0	0.000	0.000
Bridgeport, Conn.[2]	Fall 80	99	39	48	23	2.7	0.069	0.117
Santa Monica, Calif.[2]	Fall 80	124[b]	47	100	35	1.3	0.028	0.037
New Haven, Conn.[2]	Fall 80	165[b]	100	109	82	5.9	0.059	0.072
San Diego, Calif.[1]	Summer 82	279	65	N.A.	N.A.	4.0	0.062	N.A.
Louisville, Ky.[1]	Summer 82	318	31	N.A.	N.A.	0.0	0.000	0.000
Hartford, Conn.[2]	Fall 80	382	155	238	152	5.2	0.034	0.034
Buffalo, N.Y.[1]	Summer 82	473	24	N.A.	N.A.	1.6	0.067	N.A.
Orange County, Calif.[2]	Fall 80	497	175	333	100	17.0	0.097	0.170
Dallas, Tex.[1]	Summer 82	560	85	N.A.	N.A.	0.4	0.005	N.A.
Milwaukee, Wis.[2]	Fall 80	585	250	522	141	2.1	0.008	0.015
Seattle, Wash.	Fall 80	915[b]	163	818	90	54.0	0.331	0.600
	Summer 82[1]	1,026	338	N.A.	N.A.	105.0	0.311	N.A.
St. Louis, Mo.[2]	Fall 80	1,058[b]	157[c]	800	40	1.0	0.006	0.025
Detroit, Mich., SEMTA[2]	Fall 80	1,361[b]	111	318	70[d]	2.1	0.019	0.030
Washington, D.C.	Fall 80[2]	2,082[b]	150	1,700	102	5.7	0.038	0.056
	Summer 82[1]	1,691	131	N.A.	N.A.	10.0	0.076	N.A.
Los Angeles, Calif.	Fall 80[2]	2,732[b]	430[c]	1,988	159	5.0	0.012	0.031
	Summer 82[1]	2,463	1,370	N.A.	N.A.	13.0	0.009	N.A.

[1]SOURCE: Mail survey of fixed-route, fixed-schedule bus operators for NCHRP Project 8-27.

[2]SOURCE: Ref. 47.

[a]SOURCE: A Directory of Regularly Scheduled, Fixed-Route, Local Rural Public Transportation Services. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration, February 1981.

[b]SOURCE: National Urban Mass Transportation Statistics: Second Annual Report--Section 15 Reporting System. Transit financial and operating data reported for fiscal years ending between July 1, 1979, and June 30, 1980. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration, June 1982.

[c]Not all of the lift-equipped buses were being operated in accessible fixed-route bus service.

[d]More than 70 of the peak period buses were lift-equipped, but only 70 were being operated in accessible fixed-route bus service.
D3-3-XX

operators have had to face. The agency undertook an extensive marketing program to register large numbers of handicapped persons for the service. Handicapped people were involved in all phases of the planning and development of the accessible bus system. In determining which routes would have accessible bus service, Seattle Metro chose those routes with the highest volumes of transit ridership. Route 7, the accessible route with the highest level of general ridership, also had the highest level of lift usage. On an average weekday, 28 percent of the system's lift boardings occurred on this route. Route 7 served Center Park, an accessible subsidized housing development, as well as downtown Seattle, the University of Washington, and the Broadway retail district. Three other routes together accounted for 20 percent of the average daily lift boardings. Each of

these routes passed near a United Cerebral Palsy residential complex housing 100 wheelchair users. Another route serving a United Cerebral Palsy training center near downtown Seattle handled an additional 20 percent of the average daily lift boardings. Thus, a major factor underlying Seattle Metro's relatively high level of lift utilization appears to be the judicious selection of routes for lift-equipped bus service. Added to this is the often cited favorable attitude and commitment of management, staff, and drivers to make the accessible bus service work. On the other hand, there is not evidence that Seattle has a disproportionately higher incidence of wheelchair users than other urban areas (58).

Evidence from Seattle, Los Angeles, and Washington, D.C., indicates that lift use can be expected to grow. Seattle Metro's daily lift ridership kept pace with the increase in the number of lift-equipped buses in the fleet. Both the number of lift-equipped buses and the daily number of lift boardings approximately doubled in Seattle between 1980 and 1982. In Los Angeles, daily lift boardings increased by a factor of 2.6 as the percentage of the fleet that was lift-equipped jumped from 16 percent to 56 percent. In Washington, D.C., lift ridership increased 1.75 times despite a small drop in the number of lift-equipped buses.

Denied Boardings

The lift use statistics in Table 56 do not represent the true demand for lift-equipped bus service, because they omit all those occasions when a wheelchair user or semiambulatory person was unable to board a bus. Persons requiring a wheelchair lift may be left at a bus stop for one of several reasons:

- The scheduled lift-equipped bus run was missed.
- An inaccessible bus arrived at the stop instead of the scheduled lift-equipped bus.
- The lift malfunctioned or was inoperable.
- The lift could not be safely or properly deployed at the stop.
- All of the wheelchair securement positions were occupied by other wheelchair users.
- The bus was too crowded to permit the waiting wheelchair user to board

Most instances of service denial are due to the unavailability of an operable lift-equipped bus for an accessible bus run or to the breakdown of equipment on the road. Table 57 gives the percentage of scheduled accessible bus runs that were not completed for several accessible fixed-route bus systems. Although the problems that some transit operators have had with their wheelchair lifts are almost legendary, most breakdowns of accessible buses on the road have been caused by the malfunctioning of some other component of the bus. Only 10 to 15 percent of the breakdowns have been due to problems with the lifts. So far, very few wheelchair users have not been able to board lift-equipped buses either because all of the wheelchair positions in the bus were already occupied or because the bus was too crowded (47).

Table 57. Occurrence of missed accessible fixed-route bus runs.

Location	Percent of Scheduled Runs Missed
Champaign-Urbana, Illinois	< 1
Connecticut Transit	
Hartford	12
New Haven	8
Stamford	9
Palm Beach County, Florida	< 1
St. Louis	6
Seattle	< 1
Washington, D.C.	30

SOURCE: Ref. 47.

The frequency of denied boardings varies among existing accessible bus systems. Table 58 shows that the percentage of attempted boardings that are not completed ranges from less than 1 percent in Champaign-Urbana, Illinois, to 58 percent in Stamford, Connecticut. These figures may be conservative because they are based on information provided by bus drivers. Although drivers are required to report any denied boardings, they do not always do so for fear it may reflect unfavorably on them (47). Nevertheless, the table does indicate that, for some accessible fixed-route bus systems, denied boardings have been a significant problem.

Table 58. Denied lift boardings on accessible fixed-route bus systems during the summer and fall of 1980.

Location	Percent of Attempted Boardings Denied
Champaign-Urbana, Illinois	< 1
Connecticut Transit	
Hartford	7
New Haven	7
Stamford	17
Palm Beach County, Florida	4
Seattle	1-2
Washington, D.C.	11

SOURCE: Ref. 47.

Persons Benefiting from Accessible Bus Service

The low lift utilization rates presented in Table 56 indicate that accessible fixed-route bus services have not penetrated the wheelchair user market to any significant degree. In fact, there is some evidence that most lift boardings are being made by a small number of people. In St. Louis, for example, of the 1,026 lift boardings made during the first 11 months of accessible bus service, 92 percent were made by 40 individuals. These people constituted only 2 percent of the estimated 1,983 wheelchair users living within ¼ mile of one of the accessible bus routes. Moreover, only 13 of these 40 wheelchair users use the accessible buses more than 10 times during the 11-month period (47). In Palm Beach County, Florida, only five persons accounted for a majority of the reported lift boardings. These people represented only 0.5 percent of the estimated wheelchair users in the County (47). In Seattle, the area served by the fixed-route transit system contains an estimated 2,000 wheelchair users. Based on a survey of wheelchair users who were using the lift-equipped buses, it appears that the 73 respondents constituted a substantial fraction, if not a majority, of all the lift users in late 1980 (58). Although the situation may change, it appears at this time that, in most cities with an accessible fixed-route bus system, only a few wheelchair users and semiambulatory persons are benefiting from the service.

Only a small amount of data is available on the types of transportation handicapped people who are using accessible fixed-route bus services. Table 59 compares the characteristics of handicapped persons who use the accessible bus services in Palm Beach County, Florida, and Washington, D.C., with the characteristics of handicapped nonusers.

In both places, a number of dissimilarities between users and nonusers were found. However, for many of the characteristics, the differences found in Palm Beach County were the opposite of those found in Washington, D.C. For example, accessible bus users in Palm Beach County were

Table 59. Comparison of handicapped users and nonusers of accessible fixed-route bus services in Palm Beach County, Florida, and Washington, D.C.

Market Segment	Palm Beach County, Fla.		Washington, D.C.	
	Percent of Handicapped Users	Percent of Handicapped Nonusers	Percent of Handicapped Users	Percent of Handicapped Nonusers
65 years of age or older	30	15	2	22
Under $10,000 household income	56	45	36	49
Employed	10	22	60	31
Live alone	28	17	41	34
Type of handicap:				
• Difficulty climbing stairs	100	87	87	86
• Difficulty walking	95	77	67	77
• Difficulty maneuvering through crowds	50	63	58	65
• Difficulty waiting outside for buses	35	57	38	53
• Difficulty standing in moving vehicles	65	73	82	77
• Difficulty maintaining balance while bus stops and starts	55	58	56	69
• Unable to reach or hold grips	20	38	20	35
• Difficulty using coins and tickets	20	30	--	--
• Communication difficulty	15	2	11	10
• Visual difficulty	20	7	9	12
• Difficulty in understanding the system	15	12	9	12
Types of aids used:				
• Wheelchair	65	82	81	61
• Walker	15	10	6	4
• Crutches	5	7	23	19
• Walking cane	15	12	13	21
• Braces	10	5	13	10
• Artificial limb	-	2	4	5
• Guide dog	-	-	2	1
• White cane	-	-	2	3
• Escort	25	12	-	-
• Special car controls	-	13	-	-
• Personal lift-van	-	30	-	-
• Other aids	5	5	-	2
• No aids	5	2	2	N.A.
Live within two blocks of a bus stop	63	33	-	-
Have household automobile	-	-	71	73

SOURCE: Palm Beach County, Florida--Ref. 59; Washington, D.C.--Ref. 44.

more likely to be elderly, whereas in Washington, D.C., the nonusers were more likely to be elderly. In Palm Beach County, accessible bus users were more likely to have household incomes under $10,000, whereas the opposite was true in Washington, D.C. Accessible bus users in Palm Beach County were much less likely than nonusers to be employed, whereas in Washington, D.C., the users were much more likely than the nonusers to be employed. In Palm Beach County, the accessible bus users were more likely to have difficulty walking, but less likely to use wheelchairs, compared to nonusers. In Washington, D.C., on the other hand, the users were less likely than the nonusers to have difficulty walking but were more likely to use wheelchairs. These opposite findings suggest that the transportation handicapped populations in the two urbanized areas are different and that the two accessible fixed-route bus systems are each attracting different market segments of their local transportation handicapped populations. The sample sizes, however, were very small in each case and may not be representative of the user and nonuser populations.

The data in Table 59 indicate that nonusers of accessible bus services may be more likely than users to have various other types of handicap besides difficulty climbing stairs and difficulty walking. In Palm Beach County, Florida, the group of nonusers contained higher percentages of people who have difficulty maneuvering through crowds, waiting outside for buses, standing in moving vehicles, reaching or holding grips or overhead handrails, and using coins and tickets. Nonusers in Washington, D.C., were more likely to have difficulty walking, maneuvering through crowds, waiting outside for buses, maintaining their balance while the buses are starting and stopping, and reaching and holding grips. Many nonusers, therefore, may simply have too many handicaps to be willing or able to use the accessible buses.

Two other factors that separate the users from the nonusers are the distance from the transportation handicapped person's home to the nearest bus stop and the degree of difficulty the transportation handicapped person has in reaching the closest bus stop. Table 59 shows that in Palm Beach County, nearly two-thirds of the users live within two blocks of a bus stop while only one-third of the nonusers live that close to the bus system. Table 60 shows that nonusers in Palm Beach County tend to have greater difficulty with curbs, inclines, rough street surfaces, lack of sidewalks, and major streets than do the accessible bus users. users, therefore, generally seem to face barriers in getting to the accessible buses.

Table 60. Comparison of handicapped users and nonusers of accessible fixed-route bus service in Palm Beach County, Florida, by degree of difficulty to the bus stops.

Type of Barrier	Degree of Difficulty With Barrier[a]	
	Handicapped Users	Handicapped Nonusers
Curbs	1.25	1.65
Inclines	1.06	1.14
Rough street surfaces/lack of sidewalks	0.94	1.55
Crossing major streets	1.37	1.52
Other	0.30	0.15

[a]Average response based on the following scale:

2 = serious problem
1 = slight problem
0 = no problem

SOURCE: Ref. 59.

Reasons for Not Using Accessible Buses

Surveys have been conducted in St. Louis, Washington, D.C., and Seattle to determine why many wheelchair users do not ride the lift-equipped buses.

The main reasons for not using the accessible bus system in St. Louis had nothing to do with the quality or level of the bus service. Table 61 shows that the most important reasons were:

- Inability to go out at all without help.
- The availability of other transportation.
- The lack of curb cuts in the community.
- The difficulty of getting to and from the bus stops (61).

Similar findings were obtained in Washington, D.C., and Seattle. Many of the handicapped people who did not use the lift-equipped buses in Washington indicated that they preferred to travel by automobile either as drivers or as passengers. They also cited the difficulty they had getting to and from the bus stops. Level of service was also a factor. Many wheelchair users did not use the accessible bus service in Washington either because the buses did not go to the places where the people wanted to travel or because the buses did not run

Table 61. Relative importance of reasons given by wheelchair users for not using the accessible bus systems in St. Louis.

Rank Order	Reason	Average Ordinal Value[a]
1	I cannot go out at all without help.	3.61
2	I do not need accessible buses. I have other transportation available.	3.49
3	Lack of curb-cuts near my home or destination.	3.14
4	It is too difficult for me to travel on sidewalks or roads to reach the bus stop.	2.93
5	Bad weather such as rain, snow, or cold.	2.53
6	Accessible routes do not go near my home.	2.28
7	Bus transportation takes too long or is too inconvenient compared to a car.	2.22
8	Accessible routes go near my home but do not go near my destination.	2.22
9	I can not get on the bus lifts very easily.	2.19
10	Cars parked in the bus stop prevent me from reaching the bus.	1.92
11	I have trouble obtaining the schedule of accessible buses.	1.81
12	I am afraid to try the buses because I have heard bad things about them.	1.70
13	The lifts are unreliable and sometimes do not work.	1.70
14	The buses are unreliable and do not keep to the published schedule.	1.6
15	I do not feel safe on the lifts or on the buses.	1.58
16	Buses are too crowded when I want to use them.	1.47
17	I do not like going out in public.	1.29

[a]Based on a scale from 1 (not important) to 5 (very important).

SOURCE: Ref. 61.

when the people wished to travel (36). In Seattle, nearly half of the handicapped nonusers surveyed did not travel by accessible bus because they could not get around by themselves and, therefore, were not able to get to and from the bus stops. Other frequently mentioned reasons for not using the accessible buses in Seattle were lack of service to desired destinations, preferences for other modes of transportation, and the unwillingness of many to wait outdoors for a bus (58).

Users of the EASYRIDE specialized transportation service in New York City were asked whether or not they could have taken a lift-equipped bus for a trip made on the specialized service. Table 62 shows that over 60 percent indicated they could not have taken a fixed-route accessible bus if one were available. The two primary reasons for this were the inability of many respondents to get to a bus stop and the perception that the buses did not go to the respondents' destinations (62).

Table 62. Potential use of fixed-route accessible public transit among users of the EASYRIDE specialized transportation service in new york city.

	Number	Percent
Could trip have been made on a regular public bus if they were equipped with lifts?		
Yes	57	37
No	94	61
Don't know	4	2
Total	155	100
If no, why not?		
Cannot get to bus stop	40	43
Bus does not go where I want to go	13	14
No bus near where I live	0	0
Cannot ride bus alone	0	0
Feel unsafe on a bus	5	5
Cannot afford a bus	4	4
Cannot wait for a bus at bus stop	4	4
Cannot use a bus in bad weather	2	2
Other	26	28
Total	94	100

SOURCE: Ref. 62.

Effect on Mobility

Very little data are currently available on how much more often lift users travel because of the accessible fixed-route bus services. In St. Louis, it was estimated that 30 percent of the lift-equipped bus trips taken by wheelchair users would not have been made if accessible fixed-route bus service were not available (61). A survey of 73 lift users in Seattle (58) revealed that, because of the lift-equipped buses:

- Twenty-five percent of the respondents were less dependent on others.
- Twenty-three percent were able to shop more often.
- Fourteen percent were able to go to places for entertainment more often.
- Twelve percent were able to visit friends and relatives more often.
- Twelve percent were simply able to get out more often.
- Eight percent were able to get a job.
- Seven percent were able to go to school.
- Five percent were able to engage in recreational activities more often.

Altogether, about four out of every five lift users surveyed in Seattle said there were things they could either do now or do more often because of the lift-equipped buses. Although data on the average daily trip rates of lift users before and after the introduction of accessible bus service are lacking, the limited indirect evidence available suggests that many of the few handicapped people who are using the lifts are able to travel more often.

Switching from Other Modes

Although some handicapped persons have been able to increase their trip-making because of the lift-equipped buses, it appears that many lift users have simply switched to the bus system from some other mode for at least some of their bus trips. In St. Louis, for example, it was estimated that the following percentages of bus trips by lift users were diverted from other modes:

- Fifty-four percent of the bus trips would have been made as auto passengers.
- Eleven percent would have been made by driving automobiles.
- Five percent would have been made by walking or traveling in wheelchairs (61).

Thus, 70 percent of the bus trips made by lift users in St. Louis would have been made by some other mode if the accessible fixed-route bus service had not been available.

Of the 72 lift users surveyed in Seattle, all but six had switched some of their trips from some other mode to the lift-equipped buses (58). The most commonly made shift was from an auto passenger to a bus rider. Twenty-eight of the 72 lift users surveyed made this switch, primarily because the accessible bus system made them less dependent on others for transportation. Fourteen people switched some of their taxi trips to the lift-equipped buses, mainly to save money but also, to lesser extent, to achieve more independence. Instead of driving their cars, 12 of the lift users began making some of their trips on the accessible bus system. Their primary reasons for switching modes were to save either gasoline or money. Another 12 of the 72 lift users surveyed began using the lift-equipped buses instead of social service agency transportation services and other van services. Most of them made this change because they believed the lift-equipped buses gave them greater independence. Unfortunately, there is no information currently available from Seattle on what percent of the bus trips made by lift users were new trips and what percent of the trips were diverted from some other mode.

Specialized Transportation Services

Ridership and Market Penetration

Published data on ridership and market penetration are available for only a few of the major specialized transportation systems in existence. Table 63 summarizes this information. As the table shows, these systems normally provide service not only for handicapped people but also for elderly people, persons with low income, and other groups

Table 63. Utilization of Specialized Transportation Services.

System	Markets Served	Eligible Population	Percent Registered	Passenger Trips per Month	Trips Per Month per Eligible Person	Trips per Month per Registrant	Percent of Trips by Wheelchair Users
Ann Arbor, Mich., Teltran (35,63)	Handicapped	4,130[a]	N.A.	2,400[b]	0.6	N.A.	55
Austin, Tex., Special Transit Service (5)	Handicapped	24,394	8	9,000[c]	0.4	4.5	20
Naugatuck Valley, Conn., Transit District (36,64)	Elderly (E); handicapped (H); low income	1,000 (H) 8,500 (E)	16[d]	3,000 (H) 6,500 (E)	3.0 (H) 0.8 (E)	6.3	1[e] 3[f]
New York City, EASYRIDE (36,62)	Elderly; handicapped	25,000	16	4,232	0.2	1.1	11
Portland, Ore., LIFT (6,36)	Elderly; handicapped	22,000	27	6,414 to 8,343	0.3 to 0.4	1.1 to 1.4	18
Rochester, N.Y., Lift Line (36,65)	Elderly; handicapped	65,000	N.A.	5,000	0.08	N.A.	21
Westport, Conn., Maxytaxi (36,66)	Elderly (E); handicapped (H)	750 (H) 2,240 (E)	33 (H) 60 (E)	500 (H) 1,200 (E)	0.7 (H) 0.5 (E)	2.0 (H) 0.9 (E)	12[e] 41[f]
Proviso Township, Ill. (36)	Elderly; handicapped	14,636	N.A.	1,110	0.08	N.A.	4
Will County, Ill. (36)	Elderly; handicapped	33,540	N.A.	2,539	0.08	N.A.	9
Pomona Valley, Calif., Get About Transportation (5,35)	Elderly; handicapped	20,000	16	4,385	0.2	1.4	N.A.
Akron, Ohio, Special Citizens Area Transit (5)	Elderly; handicapped	54,895	9	15,517	0.3	3.1	N.A.
Bridgeport, Conn., Coordinated System (5)	Elderly; handicapped	32,950	N.A.	2,350	0.07	N.A.	N.A.
Spokane, Wash., YMCA Motor Pool (5)	Elderly; handicapped	56,000	N.A.	10,000	0.2	N.A.	15
San Mateo County, Calif., Redi-Wheels (5)	Handicapped	21,060[g]	13	2,825	0.1	1.0	11
San Antonio, Tex., Goodwill Rehabilitation Services Handi-LIFT (35)	Handicapped	56,000 to 70,000	3 to 4	4,263	0.06 to 0.08	2.1	N.A.
San Diego, Calif., Dial-A-Ride (35)	Elderly; handicapped	100,000	5	12,100[h]	0.1	2.4	N.A.
Atlanta, Ga., L-Bus (32)	Handicapped	100,000	N.A.	1,080[i]	0.01	N.A.	N.A.

[a]Estimated to be 3.9% of the area population 5 years of age or older, based on the results of the UMTA National Survey of Transportation Handicapped People for the North Central Census Geographic Region.

[b]Based on an average ridership of approximately 80 passenger trips per day.

[c]Based on an average ridership of approximately 300 passenger trips per day.

[d]Elderly and handicapped persons combined.

[e]Percentage of trips made by elderly and handicapped people combined.

[f]Percentage of trips made by handicapped people only.

[g]Estimated to be 4.1% of the area population 5 years of age or older, based on the results of the UMTA National Survey of Transportation Handicapped People for the Pacific Census Geographic Region.

[h]Monthly average in 1977.

[i]Based on an average ridership of 270 passenger trips per week.

SOURCE: References indicated by the underlined numbers in parentheses.

of transportation disadvantaged people. It is often difficult to separate the utilization rates for elderly, low income, and handicapped persons with the data reported in the literature because the data are often collected on an aggregate basis rather than by market segment.

Eligible persons are usually required to register with either the lead agency or the operating agency before they can begin to use the specialized transportation service. As Table 63 shows, however, only a minority of the eligible population register in most cases. Normally, fewer than one out of every four eligible persons registers for the service. In a few places, less than 5 percent have registered. Westport, Connecticut, was the only place found where a majority of the eligible population signed up for the specialized transportation service.

Because so few eligible people actually register, the number of passenger trips per month per eligible person has generally been extremely low. The utilization rates in Table 63 are considerably lower than the estimates of latent demand for specialized transportation systems presented in Chapter Three. Table 27, for example, indicates that between 0.066 and 0.101 additional trips a day per person or 1.98 to 3.03 additional trips a month per person would be made if a specialized door-to-door transportation system were available. By contrast, the utilization rates of eligible people in most cases have been below 1.0 trips a month per person. The utilization rates of persons registered to use the specialized transportation services, on the other hand, have often been within the range predicted by the analysis of latent demand.

Persons who do register tend to use the specialized transportation services infrequently. Table 63 shows that the average number of trips per month per registrant has been quite low, usually under 5 trips per month. However, as was mentioned above, this rate of utilization is consistent with estimates of latent demand from the UMTA national survey.

As was the case with accessible fixed-route bus services, most of the trips taken on some of the larger specialized transportation systems have been made by a small number of people. In Naugatuck Valley, Connecticut, the 9,500 passenger trips made by elderly and handicapped people in an average month on the specialized transportation system were taken by approximately 600 individuals (36). Thus, while the monthly trip rate per registrant was only 6.3, the average monthly trip rate per actual user was 15.8. Likewise, in Portland, Oregon, 1,200 elderly and handicapped individuals used the LIFT system in a typical month to make 7,840 trips (36). The average user, therefore, made 6.5 trips per month on the LIFT system as compared to 1.3 trips per month per registrant. Of the eligible people who do register, only a small percentage have used the specialized transportation services regularly. In a typical month, only 15 percent of the registrants used EASYRIDE in New York City; 20 percent of the registrants used the LIFT system in Portland, Oregon; 35 percent of the persons registered made at least one trip on the Special Transit Service in Austin, Texas; 37 percent of the registrants traveled at least once on the SCAT system in Akron, Ohio; and 40 percent of the registrants used the specialized transportation services provided in Naugatuck Valley, Connecticut (5,36). Of the people who actually used the SCAT system in Akron, Ohio, 65 percent used it less than 5 times a month, 19 percent used it between 5 and 8 times a month, 8 percent used it 9 to 12 times a month, 5 percent made 13 to 16 trips a month, and only 3 percent rode on the system more than 16 times a month (5). In Naugatuck Valley, Connecticut, 44 percent of the registered elderly and handicapped persons who used the specialized transportation service in May 1977 made no more than 5 trips on the system, while 39 percent made more than 20 trips, and the remaining 17 percent made between 6 and 20 trips (64). In San Antonio, Texas, 48 percent of the handicapped people who rode on the Handi-LIFT system used it no more than once a week (35).

Persons Benefiting from Specialized Transportation Services

Certain segments of the transportation handicapped population seem to utilize specialized transportation services more often than others. Table 64 compares the utilization rates of wheelchair users and other transportation handicapped persons for several specialized transportation systems. With one exception, the average monthly utilization rate was much higher for the wheelchair users. Starks (56) points out that mentally retarded persons constitute a significant percentage of the ridership on some specialized transportation systems. For example, mentally retarded persons make 33 percent of the trips on systems in Houston and in a five-county area in southeastern Michigan, 30 percent of the trips on systems serving Riverside and Pomona Valley, California, and 25 percent of the trips made on the system in Fort Worth, Texas.

Table 64. Utilization of specialized transportation services by wheelchair users compared to other transportation handicapped persons.

System	Trips per Month per Eligible Person	
	Wheelchair Users	Transportation Handicapped Persons
Ann Arbor, Mich., Teltran (35,63)	5.73	0.27
Austin, Tex., Special Transit Service (5)	1.35	0.30
Naugatuck Valley, Conn., Transit District (36,64)	1.65	3.09
Rochester, N.Y., Lift Line (36,65)	0.78	0.06
New York City, EASYRIDE (36,62)	0.84	0.15
Portland, Ore., LIFT (6,36)	0.96	0.29
San Mateo County, Calif., Redi-Wheels (5)	0.27	0.13
Spokane, Wash., YMCA Motor Pool (5)	2.37	0.15
Sioux Falls, S.D., Project Mobility (67)	3.33	0.30
Broward County, Fla., Social Service Transportation (67)	2.55	N.A.
Minneapolis, Minn., Project Mobility (67)	2.94	N.A.
Orange County, Calif., Dial-A-Lift (67)	1.03	N.A.
San Bernardino, Calif., Dial-A-Lift (67)	3.13	N.A.

SOURCE: Estimated from data reported in the references indicated by the underlined numbers in parentheses. Unless specified in the references, the numbers of wheelchair users and other transportation handicapped persons were estimated from incidence rates derived by the UMTA national survey of transportation handicapped people.

Some of the better information on the characteristics of users of specialized transportation services comes from a study sponsored by UMTA in 1980 (68). Both users and nonusers of specialized services were interviewed in four small urban areas: Akron, Ohio; Austin, Texas; Brockton, Massachusetts; and Eugene, Oregon. Tables 65 through 68 compare the two groups by type of dysfunction, ability to use public transportation, age, employment status, and availability of automobiles.

UMTA found many differences between the users and the nonusers. Some of these differences, however, varied between the four small cities. For example, in Austin, Brockton, and Eugene, specialized transportation service users were more likely than the nonusers to be in wheelchairs. In Akron, however, the percentage of wheelchair users among the users and nonusers of the specialized transportation service was about the same. The user groups in Austin and Brockton had a much higher percentage of people with mechanical aids, while in the other two cities it was the nonuser groups that had the higher percentages of people needing mechanical aids. The specialized

Table 65. Comparison of users and nonusers of specialized transportation services in four small cities by type of dysfunction.

Type of Dysfunction	Akron, Ohio		Austin, Tex.		Brockton, Mass.		Eugene, Ore.	
	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)
Special dysfunctions (net)	56	55	92	73	79	54	67	59
• Mechanical aids	24	29	55	38	46	36	24	31
• Vision	23	22	58	37	34	21	18	24
• Hearing	25	19	32	22	31	15	14	26
• Wheelchair	5	7	30	8	12	3	39	11
Other problems (net)	44	45	8	27	21	46	33	41

SOURCE: Ref. 68.

Table 66. Comparison of users and nonusers of specialized transportation services in four small cities by ability to use public transportation.

Ability to Use Public Transit Compared to People Without Problems	Akron, Ohio		Austin, Tex.		Brockton, Mass.		Eugene, Ore.	
	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)
Not able to use regular public transportation	11	30	51	29	53	25	56	15
A lot more difficult to use regular public transportation	29	19	32	25	27	23	16	26
A little more difficult to use regular public transportation	60	51	17	46	20	52	28	59

SOURCE: Ref. 68.

transportation service users in Austin, Brockton, and Eugene were more likely to be unable to use regular public transportation, but again the opposite was the case in Akron. The user groups in Akron and Brockton had higher percentages of elderly people compared to the nonuser groups. In the other two cities, there was no significant difference in the proportion of elderly people in the two groups. Users were more likely to be employed in Austin and unemployed in the other three cities. Thus, even though there were major differences in the characteristics of users and nonusers of specialized transportation services in each of the four small cities, the composition of the user groups also differed considerably between the four communities. Each specialized transportation service attracted a somewhat different mix of eligible elderly and handicapped persons.

One relationship that did not change between the four communities was the connection between auto availability and use of the specialized transportation services. In each city, users of the specialized transportation services were less likely than the nonusers to own automobiles. The users were also less likely to have cars available all or most of the time when needed, either to drive or to ride in as passengers. This relationship has also been found in studies of a number of specialized transportation systems monitored by UMTA under the SMD program (69). These studies have found that one of the main reasons why many eligible people do not register to use a specialized transportation service is because they have other means of transportation. People who do not register tend to have higher household incomes and better access to automobiles. Frequent users of specialized demand-responsive services usually lack alternative means of transportation. They tend to have low incomes and little or no access to automobiles. In San Diego, for example, 90 percent of the specialized transportation service users had incomes below $4,000 in 1977 (35). In each of the four cities surveyed by UMTA, a large majority of the special service users did not have an automobile available to them all or most of the time when needed (68). These are the people who appear to be benefiting the most from the provision of specialized transportation services.

Table 67. Comparison of users and nonusers of specialized transportation services in four small cities by age and employment status.

	Akron, Ohio		Austin, Tex.		Brockton, Mass.		Eugene, Ore.	
	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)
Age								
65 years or older	88	53	54	53	79	51	62	62
Employment Status								
Employed	2	10	21	10	7	16	10	16
Unemployed	98	90	79	90	93	84	90	84
• Retired	47	37	25	37	51	25	57	55
• Unable to work	38	19	26	32	32	30	20	13
• Other	13	34	28	21	10	29	13	16

SOURCE: Ref. 68.

Table 68. Comparison of users and nonusers of specialized transportation services in four small cities by auto ownership and availability.

	Akron, Ohio		Austin, Tex.		Brockton, Mass.		Eugene, Ore.	
	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)
Car Ownership								
Own one or more cars	34	53	38	53	22	57	27	67
Car Availability								
Car available for passenger use all or most of the time needed	29	55	23	55	20	50	43	59
Car available to drive all or most of the time needed	22	28	7	28	3	29	8	42

SOURCE: Ref. 68.

Effects on Mobility

As yet there is very little conclusive evidence from the SMD-monitored projects that specialized transportation services have enabled transportation handicapped people to travel more often (69). Project users sometimes have higher trip rates than nonusers, but this could be due to differences in the mobility of the two groups and not a consequence of the special service. Data on the frequency of travel and modal choices of transportation handicapped people before and after the start of a specialized transportation service are lacking.

There is some indirect evidence that specialized transportation services may have enabled a few transportation handicapped people to make trips that otherwise would not have been made without the service. Some SMD project users have claimed that some of their trips would not have been made if the specialized transportation service had not been available. In New York City, for example, 43 percent of the trips made on EASYRIDE would not have been made if the service did not exist, according to users in an attitudinal survey. In Naugatuck Valley, Connecticut, 31 percent of the trips on the special service would not have been made, while in both Portland, Oregon, and Rochester, New York, 25 percent of the special service trips would not have been made (36). The results of other surveys, however, indicate that most essential trips, such as medical trips, would still be made even without a specialized transportation service (69).

Switching from Other Modes

Although extremely limited, the data that are currently available suggest that many trips made on specialized transportation systems are not new, but instead are diverted from some other mode. It is estimated, for example, that 69 percent of the trips made on the specialized transportation system in lower Naugatuck Valley, Connecticut, would have been made on some other mode (64). A survey of LIFT users in Portland, Oregon, revealed that 60 percent of the trips there would have been taken on some other mode (6). In New York City, 57 percent of the trips on EASYRIDE would have been made on another mode if EASYRIDE had not been available (62).

Reasons for not Using the Special Service

There is very little data on why many handicapped people do not use specialized transportation services. The information that is available, however, suggests that the reasons are the same in many respects as those given for not using accessible fixed-route public transit. In a survey of nonusers of the LIFT system in Portland, Oregon, over 40 percent did not patronize the service because other means of transportation, primarily the automobile, were available. Table 69 shows that less than 12 percent of the nonusers surveyed mentioned level of service factors such as problems with scheduling, lengthy travel times, and unreliable service. Unfamiliarity with the service and personal limitations were mentioned more frequently than level of service. Table 70 compares the overall opinions of users and nonusers of specialized transportation services in four smaller cities. Between 3 percent and 9 percent of the users believed the specialized transportation service was worse than other currently available means of transportation, while 26 percent to 29 percent of the nonusers held this opinion. Over two-thirds of the users in each city thought the specialized transportation service was a lot better than the other means of transportation currently available to them, whereas only 26 percent to 44 percent of the nonusers held this view. Thus, the availability of better alternative modes of transportation appears to be one of the primary factors in determining whether or not a transportation handicapped individual will use a specialized transportation service. Persons who believe the special service is an improvement over their current modes of transportation are more likely to use the service.

Table 69. Reasons for not using the lift specialized transportation service in Portland, Oregon.

Use alternative forms of transportation		42.8%
Gets rides with others	18.2%	
Drive self	11.8%	
Ride bus	10.8%	
Other agency provides	2.0%	
Lack of knowledge of service		18.1%
Did not know about LIFT	11.4%	
Did not know how to sign up	4.7%	
Did not know I was eligible	2.0%	
Personal restrictions		17.6%
Do not need, do not travel much	9.1%	
Too handicapped to use	6.1%	
Intend to register but have not	2.4%	
Service restrictions		11.6%
Scheduling too difficult	6.1%	
Trip takes too long	2.4%	
Service unreliable	1.4%	
No escort available	1.7%	
Other (all under 1.0%)		9.7%
		99.8%

SOURCE: Ref. 6.

Einstein (33) suggests a number of reasons why the use of specialized transportation services has been low thus far. These reasons fall into four categories.

1. Factors that prevent potential users from becoming aware of the service.
2. Factors that prevent potential users from obtaining the service.
3. Factors that prevent potential users from reaching the service.
4. Those characteristics of the service that make it difficult, impossible, or less desirable to use.

None of the 30 systems studied by Einstein had an effective marketing program. Many concentrated on clients of social service agencies, thereby neglecting the many transportation handicapped people who are not affiliated with such agencies. Many systems did not have enough vehicles to meet the articulated demand, particularly during certain times of the

Table 70. Users' and nonusers' opinions of specialized transportation services compared to other transportation currently available.

Compared to Transportation Currently Available, Specialized Transportation Service is:	Akron, Ohio		Austin, Tex.		Brockton, Mass.		Eugene, Ore.	
	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)	Users (%)	Nonusers (%)
A lot worse	1	10	2	6	3	7	1	13
A little worse	2	17	5	20	6	20	8	16
About the same	15	17	11	15	8	17	8	23
A little better	9	12	11	22	12	30	12	20
A lot better	73	44	70	37	71	26	71	28

SOURCE: Ref. 68.

day. Shortages of lift-equipped vehicles were especially acute in some communities. In a few cases, the service area either did not include many of the desired destinations or did not cover areas where significant demand for service existed. Other characteristics of the services studied that tended to reduce the demand included the need for transfers, the limited number of hours of operation, narrow criteria for eligibility, prioritization of trips or restrictions on the types of trips that could be made on the systems, an emphasis on subscription service to the neglect of many irregularly occurring trips, the requirement for at least one or two days' advance reservation of service, and long and sometimes unpredictable wait times and travel times. Long, severe winters and a lack of assistance in getting to and from the vehicles had a dampening effect on demand in a few of the cases studied. Some of the more minor factors that made specialized transportation services less desirable to use in some cases included the poor quality of the ride provided by some of the small vehicles that are typically used; the internal configuration of the vehicles, making it difficult for some transportation handicapped persons to move from the vehicle entrance to their seats; unreliable air conditioning; crowding in the vehicles; the attitudes of reservation clerks and other service personnel; and excessive fares for long trips. Although the effect of each of the above factors was not quantified in Einstein's study, some combination of these factors was found in each of the 30 systems analyzed.

Taxicab User-Side Subsidy Programs

Utilization and Market Penetration

As was the case with specialized transportation services, the overall utilization of user-side subsidy programs thus far has been exceedingly low. Table 71 shows that most programs have been subsidizing less than one trip per month per eligible person. Monthly subsidized trip rates ranged from 0.02 per eligible person in Santa Clara County to 2.0 per eligible person in Danville. The extremely low rate of utilization in Santa Clara County can be explained by the severe limits on subsidized travel in that area. Eligible persons were permitted no more than 16 subsidized one-way trips or eight round trips per year.

The utilization rates in Table 71 are considerably below the estimates of latent travel demand presented in Chapter Three. Table 27 showed that the estimated latend demand for individual subsidies was 0.1 additional trips per person per day or approximately three additional trips per month per person. None of the user-side subsidy programs in Table 71 had utilization rates approaching three subsidized trips per month per eligible person. The highest subsidized trip rate was 2.0 monthly trips per eligible person in Danville. Subsidized bus travel, however, accounted for 70 percent of this rate. The highest subsidized taxi trip rate was 1.2 trips per month per eligible person in Milwaukee, followed closely by a rate of 1.1 trips a month in Kinston.

Three of the five programs in Table 71 with utilization rates over 1.0 trips per month per eligible person provided user-side subsidies for both bus and taxi trips. Interestingly, between 2.1 and 6.4 times as many subsidized trips were made on the bus systems than on the taxi services. The rate at which eligible persons used the buses was 2.0 to 5.5 times greater than the rate at which they used the taxis. The large differences in the utilization of buses and taxis is not surprising given the large differences in the subsidized fares for the two modes. In Montgomery, eligible persons could ride the buses for free during off-peak hours and for only $0.15 during the peak period. By contrast, the average subsidized taxi fare was $1.30. In Lawrence, eligible elderly and handicapped persons could purchase 25 bus tickets for a total of $0.25. The average discounted taxi fare, on the other hand, was $0.75. Bus trips in Danville cost eligible persons $0.20, while the average cost of a subsidized taxi ride was $0.62 (35,43).

The rate of utilization does not seem to depend on the amount of subsidized travel permitted. Despite the absence of limits on subsidized travel in Lafayette, Pittsburgh, and Seattle, the average monthly utilization rate in these three cities was either 0.1 or 0.2 trips a month per eligible persons. In Kinston, North Carolina, on the other hand, the average utilization rate was 1.1 trips a month per eligible person, even though users were limited to $25 worth of scrip each month. Four other user-side subsidy programs with limits on the amount of subsidized travel had higher utilization rates than the unlimited programs in Lafayette, Pittsburgh, and Seattle.

As was the case with specialized transportation services, most user-side subsidy programs have attracted only a small portion of their targeted markets. Typically, less than a third of the eligible people registered with the subsidizing agencies. The two exceptions were Danville and Milwaukee. Nearly half of the eligible population registered in Danville, and a majority registered in Milwaukee County. The user-side subsidy program was so popular in Milwaukee that the Milwaukee County Transit System was allowed to discontinue the use of lifts on its regular fixed-route bus system (39). In most other urban areas, the market penetration of user-side subsidy programs has been fairly low.

Even among persons who have registered for the user-side subsidy programs, the utilization rates have been low. The highest subsidized trip rate was 6.9 trips per month per registrant in Lawrence. Over two-thirds of these trips, however, were accounted for by subsidized travel on the bus system. The highest subsidized taxi trip rate among registrants was 6.0 trips per month in the Los Angeles harbor area. Interestingly, this program attracted only 3 percent of the eligible population. Although a majority of the eligible people registered for the Milwaukee County user-side subsidy program, registrants on the average used the taxi services only twice a month. Registered persons in Montgomery, Kansas City, and Santa Clara County on the average traveled by taxi less than once a month. These low utilization rates imply that most registrants do not purchase or use all of their allotted tickets or scrip each month.

Data from a number of user-side subsidy programs confirm the above implication that many registrants do not actively participate in these programs. An active user is one who makes at least one subsidized taxi trip a month. In some programs, less than half the registrants were active users. The percentage of registrants making at least one subsidized taxi trip in any given month was 10 percent in Montgomery, 33 percent in Fremont, and 34 percent in Danville (36,37, 43). In Milwaukee, 42 percent of the registrants who use crutches and 25 percent of the registrants in wheelchairs were active users (39). Half the registrants in San Leandro made at least one subsidized taxi trip during an average month (37). The highest reported rate of participation was in Kinston, North

Table 71. Utilization of user-side subsidy programs.

Site of Program	Eligible Persons	Eligible Population	Percent Registered	Limits on Subsidized Travel	Subsidized Trips per Month	Trips per Month per Eligible Person	Trips per Month Per Registrant
Danville Ill., (43)	Over 65; handicapped	7,500	47	$20 total undiscounted fares per month	4,500 taxi 10,660 bus 15,160 total	0.6 taxi 1.4 bus 2.0 total	1.3 taxi 3.0 bus 4.3 total
Montgomery, Ala. (43)	Over 65; handicapped	18,600	30	$30 total undiscounted fares per month	3,290 taxi 21,100 bus 24,390 total	0.2 taxi 1.1 bus 1.3 total	0.6 taxi 3.8 bus 4.4 total
Kinston, N.C. (43)	Over 65; handicapped	2,860	24	$25 total undiscounted fares per month	3,200	1.1	4.6
Lawrence, Mass. (43)	Over 65; handicapped	12,500	26	$20 total undiscounted fares per month	7,000 taxi 15,000 bus 22,000 total	0.6 taxi 1.2 bus 1.8 total	2.2 taxi 4.7 bus 6.9 total
Kansas City, Mo. (41)	Over 65; blind; persons requiring wheelchairs, crutches, or canes	58,400	22	25 trips per month	10,570[a]	0.2	0.8
Los Angeles Harbor Area (42)	Over 60; handicapped; on welfare	30,000	3	20 trips per month	5,986	0.2	6.0
Pittsburgh, Penn. (36,40)	Handicapped persons unable to use regular transit	21,000	9	None	4,197[b]	0.2	2.3
San Leandro, Calif. (37)	Over 60 and physically unable to use transit	2,600	15	10 trips per month	637	0.2	1.6
Santa Clara County, Calif. (37)	Over 60 and physically or emotionally handicapped	20,500	4	16 trips per year	497	0.02	0.6
Palo Alto, Calif. (37)	Mobility-impaired persons meeting low-income requirements	2,500	27	$20 total undiscounted fares per month	1,650	0.7	2.4
Lafayette, Calif. (37)	Over 65	2,413	6	None	475	0.2	3.4
Fremont, Calif. (37)	Over 60 and physically unable to use transit	1,250	32	16 trips per month	413	0.3	1.0
Seattle, Wash. (38)	Over 65 and/or handicapped and having low-income	76,900	13	None	10,000	0.1	1.0
Milwaukee, Wis. (39)	Blind; persons requiring wheelchairs, walkers, or crutches	11,700	60	None	14,000	1.2	2.0

[a]Combined ridership for all participating carriers: taxis, social service agencies, Medicab, and the city.

[b]Combined ridership for the three taxi operators and four private, nonprofit carriers participating in the program.

SOURCE: References indicated by the underlined numbers in parentheses.

Carolina. Nearly two-thirds of the registrants in that community were active users (36).

The average utilization rates of active users have generally been below the limits placed on monthly subsidized travel. In Fremont, California, active users averaged 4.4 taxi trips per month. Only 5 percent made more than ten taxi trips per month, while 56 percent made between three and ten trips, and 39 percent made only one or two trips. The limit was 16 trips per month per person (37). Active users in San Leandro, California, averaged 5.1 subsidized trips per month, whereas the limit was ten trips per person or 14 trips per couple. Nearly 9 percent of the active users went over the limit, while 55 percent made between three and ten trips per month, and 36 percent took only one or two taxi trips (37). In Montgomery and Danville, less than 10 percent of the active users took their monthly allotment of subsidized trips, and only 25 to 30 percent made more than five taxi trips per month. The average active users in Montgomery averaged 5.1 monthly trips (43). Active participants in the Milwaukee County program averaged between five and eight trips a month, depending on their type of handicap (39). Kinston not only had the highest reported participation rate, but also the highest average utilization rate among active users. The average active user in Kinston made 7.9 taxi trips a month (36). Because taxis are the only mode of public passenger transportation in Kinston, the relatively high rates of participation and utilization in that community are not too surprising.

Persons Benefiting from the Subsidies

The potential beneficiaries of user-side subsidies have varied by program. Table 71 shows that not all programs serve the same market segments. In general, however, user-side subsidy programs have focused on people who are dependent on public transportation, but who either have physical difficulty using conventional transit or do not have access to a public transit system. Moreover, many programs were specifically intended for transit-dependent people who cannot afford to use taxis for the bulk of their travel.

As was the case with specialized transportation services, user-side subsidy programs have tended to attract those people in the targeted market segments who have little or no alternative transportation available to them. Table 72 compares some of the more salient characteristics of registrants and nonregistrants for three SMD-monitored user-side subsidy programs as well as the characteristics of active users, registered nonusers, and eligible nonregistrants in Kinston and Montgomery. Project registrants in each case were much more likely than the nonregistrants to be without driver's licenses or to live in households without automobiles. The groups of registrants also had a slightly higher percentage of people with household incomes below $5,000. Frequent users in Kinston and Montgomery were especially in need of subsidized public transportation. These people were even more likely than the registered nonusers to be without driver's licenses or to have limited or no access to private

Table 72. Characteristics of registrants and eligible nonregistrants for three SMD-monitored user-side subsidy programs.

Site of Project	Eligible Population Group	Percent with No Driver's License	Percent with No Autos in Household	Percent with Household Income Under $5,000	Percent Requiring a Mobility Aid[a]
Kinston, N.C.	Project registrants	88.8	84.7	89.9	26.9
	Registered frequent users	94.0	92.2	93.8	36.3
	Registered nonusers	74.4	70.8	81.9	21.0
	Eligible nonregistrants	46.0	22.3	73.4	17.8
Danville, Ill.	Project registrants	75.0	N.A.	73.0	24.0
	Eligible nonregistrants	39.0	N.A.	41.0	24.0
Montgomery, Ala.	Project registrants	66.9	55.5	74.4	13.8
	Registered frequent users	84.0	74.7	77.8	21.6
	Registered nonusers	62.5	50.3	73.1	12.5
	Eligible nonregistrants	42.3	21.5	65.9	22.1

[a]Wheelchair, walker, cane, or crutches.

SOURCE: Ref. 36.

automobiles. They also tended to have incomes even lower than those of the other registrants. Most active users, therefore, would have had difficulty affording many taxi trips without the user-side subsidies. Similar findings were made in Seattle (38). Most of the taxi scrip users there also did not have driver's licenses or easy access to automobiles.

The relationship between physical disability and subsidized taxi usage is not nearly as pronounced as the relationship between user-side subsidy utilization and auto availability. An interesting case is Seattle where, in addition to the user-side subsidy program, an extensive accessible fixed-route bus system is in operation. As Table 56 earlier in this chapter showed, Seattle Metro has had by far the highest rate of lift use of any transit system in the country. Despite the availability of the taxi scrip program, daily lift boardings nearly doubled between 1980 and 1982. Most of the lift users were confined to wheelchairs and were under the age of 65. Taxi scrip users, on the other hand, were mostly elderly people with low incomes who generally did not have severe physical disabilities (38). In Milwaukee, nearly 70 percent of the registrants used wheelchairs, but only 25 percent of the registered wheelchair users traveled by taxi at least once a month under the user-side subsidy program. Table 72 shows that frequent users in Kinston and Montgomery were more likely than the registered nonusers to need some type of mobility aid. However, there was no consistent relationship between the need for a mobility aid and registration for the three SMD-monitored programs. In Kinston, registrants were more likely than nonregistrants to require either crutches, canes, walkers, or wheelchairs, while the reverse was true in Montgomery. In Danville, the eligible nonregistrants were just as likely to need mobility aids as were the project registrants.

Effects on Mobility

Because of the low utilization rates and the small percentages of registrants who are active users, user-side subsidy programs generally have affected the mobility of only a very small number of people. Some users have claimed in attitudinal surveys that they are able to travel more often because of the user-side subsidies (55). As yet, however, there is no solid evidence that user-side subsidy programs have enabled registered persons to travel more often, to make trips to new places, or to make trips that they otherwise would not have taken.

Some preliminary findings from the SMD-monitored programs indicate that large numbers of subsidized taxi trips would have been made by taxi even without the subsidized taxi fares. The percentage of subsidized taxi trips previously made by taxi at full fare was 45 percent in Montgomery, 50 percent in Danville, and 84 percent in Kinston (55). To the active users, therefore, the primary benefit has been to reduce their cost of traveling by taxi. For the large numbers of registrants who do not actively participate, the user-side subsidy programs have merely provided an alternative means of transportation in the event that their primary mode becomes unavailable (36,55).

Switching from Other Modes

Some of the taxi trips made under user-side subsidy programs have been diverted from other modes. This was the case for an estimated 31.5 percent of the subsidized taxi trips in Montgomery, Alabama (70), and 23.7 percent of the subsidized taxi trips in Lawrence, Massachusetts (71). In Kinston, North Carolina, only 6.0 percent of the subsidized taxi trips were diverted from other modes (72). These percentages are considerably below those reported for some specialized transportation systems. Thus, mode-switching does not appear to be as prevalent among subsidized users of taxi services as it is among users of specialized transportation systems.

Reasons for Not Using the Subsidies

There is very little information on why many eligible persons do not even bother to register for user-side subsidy programs, or why registered persons do not take greater advantage of the subsidies. Sponsoring agencies seldom make the effort to locate and interview eligible people who have not registered. In Kinston, over one-third of the registrants stated that they were already using the taxis as much as they needed. Many of the registered nonusers preferred other modes of transportation and only registered with the program to have a substitute mode of transportation in case their principal mode became unavailable (36).

Given the relatively low incomes of eligible persons under most programs, one possible reason for the low utilization rates is the undiscounted part of the taxi fare. Even with the discount, the cost of the subsidized taxi ride is often higher than the typical fare for transit. The average user fare was $0.50 in Kansas City, $0.62 in Danville, $0.75 in Lawrence, $0.76 in Kinston, and $1.30 in Montgomery (43). Users in Milwaukee County had to pay a base taxi fare of $1.50 (39). For people with limited incomes, even these relatively low taxi fares can be unaffordable if paid very often.

Mobility Training Programs

Rates of Success

Mobility training programs have generally been highly successful at training mentally retarded persons in the use of fixed-route bus systems. The following percentages of clients were successfully trained under several existing programs (57):

- Ninety-nine percent by the Center in Mental Retardation in Los Angeles during the first year of the program.
- Ninety-nine percent during the first year of the Mobility Training Program in Sacramento.
- Eighty-five percent of the children trained by the New York City Board of Education between 1972 and 1982.
- Eighty percent at the Ray Graham Center in Chicago during the first year of the program.
- Seventy-two percent during the first year of the program run by the Wayne County Association for the Retarded in Detroit.

These success rates refer only to the ability of the retarded person to use transit independently and not to whether or not the individual actually used transit after training was completed. They support the contention that a large majority of mentally retarded people can be trained to travel independently by transit.

Post-Training Utilization of Transit

Information on the percentage of mobility trained retarded persons who continued to use transit following completion of their training was

found for only two programs (57). In Sacramento, 89 percent of the trained clients continued to use transit. In Wayne County, Michigan, only 56 percent of the trained clients continued to travel by bus.

There are several reasons why some mobility trained retarded persons have not continued to use transit. A few have had no immediate need to use transit. Others have stopped using transit because they no longer needed to reach a particular destination. Some never used transit following the successful completion of their training program because their parents or guardians were still reluctant to let them travel by themselves. This last situation appears to be significant barriers to a more widespread acceptance of mobility training programs (44).

ATTITUDES TOWARD ALTERNATIVES

The effectiveness of any transportation service will depend on how closely the attributes of the service conform with the requirements or preferences of transportation handicapped people. Only a small amount of research has been done in this area. In one recent study, Falcocchio (73) interviewed 150 handicapped people to determine the relative importance of 12 service variables. Wheelchair users gave considerable weight to the ease of getting on and off the vehicles; the reliability of the service; safety from falling; waiting time; absence of sudden starts, stops, and turns; and the fare. Other handicapped persons emphasized the availability of a seat, walking distances to and from the service, and the ease of getting on and off the vehicles. Using the results of the survey, Falcocchio developed a set of transportation design standards for different segments of the transportation handicapped population.

One of the objectives of the mail survey of handicapped people conducted for NCHRP Project 8-27 was to gain some further insight into what attributes of a transportation service are important to transportation handicapped people. On a scale of 1 to 5, respondents were asked to indicate how important each attribute was in choosing a means of transportation. Table 73 compares the average responses of the wheelchair users with those of the other transportation handicapped respondents. The higher the average score, the greater was the degree of importance attached to the attribute by the respondents. The attributes are arranged in the order of their importance to the wheelchair users.

Table 73. Relative importance of transportation service attributes to wheelchair users and other transportation handicapped persons.

Transportation Service Attribute	Average Degree of Importance[a]		
	Wheelchair Users	Other Transportation Handicapped People	Difference
To be able to go wherever you want to go	4.49	3.78	0.71
To be able to go when you want to go	4.18	3.59	0.59
To be able to get in and out of the vehicle with little or no trouble	4.12	2.79	1.33
To be safe from crime	3.78	3.65	0.13
To not have to go very far to get to the vehicle	3.53	2.85	0.68
To be able to get there without having to change vehicles	3.52	2.86	0.66
To get there in as short a time as possible	3.48	3.15	0.33
To not have to wait very long for a ride	3.44	3.33	0.11
To get a ride without having to make a reservation	3.43	2.70	0.73
To be able to go to more than one place on the same trip	3.34	2.44	0.90
To be able to afford the ride	3.24	2.96	0.28
To have someone to help you who knows how to help a person with your disability	3.22	2.58	0.64
To ride without sudden starts, stops, and turns	2.95	2.42	0.53
To have lots of room while you are riding	2.49	2.24	0.25
To ride by yourself	2.47	1.93	0.54
To ride for free	2.11	1.89	0.22

[a]Based on the following scale = (1) Not important at all; (2) Somewhat important; (3) Important; (4) Very important; (5) Of greatest importance.

SOURCE: Mail survey of transportation handicapped people registered with one of 10 national private, nonprofit social service organizations, conducted for NCHRP Project 8-27.

Wheelchair users on the average considered almost all of the service attributes to be important. Of greatest importance to them was the flexibility to travel to wherever they wanted to go at whatever time they wanted to leave. Also of greatest importance to most of the wheelchair users was the ability to get in and out of the vehicles with little or no difficulty. Security from crime, proximate service, and no need for transfers were other service attributes that many of the wheelchair users deemed to be very important. Only three of the attributes were of minor importance to most of the respondents in wheelchairs. They generally did not give much consideration to having lots of room, nor did they especially care to travel by themselves or for free.

The most important attributes of a transportation service to the other transportation handicapped respondents were the ability to travel to any place, security from crime, and the ability to travel at any time. Only two other attributes were considered important by the average respondent not confined to a wheelchair: short waiting times and short travel times. All of the remaining attributes were regarded as being somewhat less than important. To most of the respondents not in wheelchairs, privacy and free transportation were not important considerations at all.

The wheelchair users consistently placed a higher average degree of importance to each attribute than did the respondents not in wheelchairs. The largest difference between the groups was in the relative importance of being able to get in and out of the vehicles easily. Not surprisingly, this was a great concern to most of the wheelchair users, but was not a major consideration to many of the other transportation handicapped respondents. Another attribute that received widely different average responses from the two groups was the ability to make more than one stop while on a trip. To the average wheelchair user, this was an important attribute, while to the average person in the other group, this attribute was only somewhat important. Differences greater than half a scale value in the average responses of the two groups also existed for eight of the other service attributes. The most significant of these were the differences in the perceived importance of not having to make a reservation, being able to go wherever desired, not having to go very far to access the service, not having to transfer between vehicles, and having someone available who is competent at providing any required assistance. On the other hand, there was very little difference between the wheelchair users and the other transportation handicapped respondents on the perceived relative importance of safety from crime and short waiting times.

The respondents in the mail survey were subsequently presented with four statements describing alternative approaches to improving the mobility of transportation handicapped people. They were asked to indicate on a scale from 1 to 5 the degree to which they agreed or disagreed with each statement. The average responses of the wheelchair users and the other transportation handicapped respondents are compared in Table 74.

Wheelchair users strongly agreed that specialized transportation services should be provided for physically disabled persons. However, they also strongly agreed that existing local bus services should also be made accessible to handicapped people. They were somewhat more indifferent to subsidized taxi fares or other individual financial aid for transportation, although they generally tended to favor either of these approaches.

The other transportation handicapped respondents also strongly favored accessible bus systems and specialized door-to-door transportation services. Interestingly, they were much more inclined to favor subsidized taxi fares than were the wheelchair users. The average person not in a wheelchair agreed with this approach. Like the wheelchair users, the other transportation handicapped respondents were somewhat indifferent to the provision of financial aid to individuals to purchase any usable transportation, although they were more likely to approve rather than disapprove this approach.

The results of the survey showed that there was no strong opposition to any of the four general solutions. On the contrary, there was strong support for both accessible bus systems and specialized transportation services. The survey results, however, do not indicate which of these two approaches would be more preferable if transportation handicapped persons had to choose between them.

Table 74. Acceptability of alternative transportation solutions to wheelchair users and other transportation handicapped persons.

Statement of Alternative	Average Response[a]		
	Wheelchair Users	Other Transportation Handicapped People	Difference
A special door-to-door transportation service should be provided for people with physical disabilities.	4.41	4.42	-0.01
The local public bus system should be made accessible to people with physical disabilities.	4.24	4.48	-0.24
People with physical disabilities should be allowed to use the local taxi service at a lower fare.	3.60	4.06	-0.46
People with physical disabilities should be given financial assistance by the government to help them pay for any transportation service they can use.	3.51	3.60	-0.09

[a]Based on the following scale: (1) Very strongly disagree; (2) Generally disagree; (3) Neither agree nor disagree; (4) Generally agree; (5) Very strongly agree.

SOURCE: Mail survey of transportation handicapped people registered with one of 10 national private, nonprofit social service organizations, conducted for NCHRP Project 8-27.

SUMMARY

Four approaches have been taken in various communities to improve the mobility of transportation handicapped people. In some large as well as small cities, existing fixed-route bus systems have been modified to make them more accessible to transportation handicapped people. Other communities have implemented specialized door-to-door transportation services exclusively for handicapped people and, in some cases, other persons with limited resources for transportation. Still other communities have opted for individual subsidies to enable transportation handicapped persons and other disadvantaged people to travel by taxi at reduced fares. Programs have been established in a few places to train mentally retarded persons in the use of existing bus transit systems. In a few urban areas, more than one of these approaches has been tried, often at the same time.

The most visible feature of an accessible fixed-route bus system is the wheelchair lifts that enable wheelchair users and certain other transportation handicapped people to get on and off the buses more easily. Wheelchair lifts alone, however, are generally not sufficient to make a public bus system more accessible. Other physical components of the system may also need to be modified. These include other features on the buses as well as bus stops, park-and-ride lots, transit information centers, ticket outlets, and route maps and schedules. No less important are the operational aspects of the system. These include vehicle operating policies and practices; lift maintenance; special training for drivers, mechanics, and other transit personnel; marketing and promotional activities; and programs to educate handicapped persons on the use of the lifts.

Whereas the accessible bus alternative involves making changes to an existing system, the specialized transportation service alternative usually entails the creation of an entirely new system, although in a few instances, attempts have been made to consolidate or coordinate the numerous highly specialized transportation services often provided by social service agencies and private, nonprofit organizations. Specialized transportation services generally solve the problem many transportation handicapped people have of getting to and from the vehicles by providing door-to-door transportation. There are, however, numerous variations of this alternative. Specialized transportation systems have differed from each other in many ways, including the types of services provided, routing, scheduling and reservation of service, types of trips served and prioritization of trips, size and subdivision of the areas served, fleet size and composition, the types of personal assistance offered, fares, organizational structure and management, and the markets served. No two systems are entirely alike.

The third alternative normally does not involve the modification of an existing service, nor does it usually entail the creation of an entirely new system. Instead, the rationale of user-side subsidies is to enable transportation handicapped persons to make better or more frequent use of transportation services already provided by various private carriers. Under this alternative, eligible persons purchase tickets, scrip, or voucher coupons at a fraction of the face value to be used to pay for transportation provided by the participating private operators. The taxi companies or other participating transportation providers in turn redeem the tickets, scrip, or voucher coupons with the subsidizing agency. Limits are often placed on the amount of subsidized travel and the maximum subsidy per trip. Other aspects of user-side subsidy programs that vary between applications are the mechanism or medium by which the subsidies are conveyed to eligible individuals, the discount on the taxi fare, policies concerning group riding, advanced reservation requirements, areal coverage, special provisions for people who cannot transfer from their wheelchairs, the amount and types of personal assistance provided, the type of subsidizing agency, the number and types of service providers, and the specific markets to be served.

For blind people and mentally retarded persons, there is a fourth alternative. Unless they have a physical handicap as well, these people are generally physically capable of boarding and riding in regular fixed-route buses. However, they usually require special training in order to do so. Mobility training programs can provide blind persons and mentally retarded people with the necessary skills to travel independently by transit. Obviously, the training techniques for blind people will be quite different from the ones for mentally retarded persons.

The four alternative approaches have vastly different cost structures.

The cost of providing and operating an accessible fixed-route public transit system consists of the marginal or additional cost of making the existing system more accessible and usable for handicapped people. It includes the capital cost of wheelchair lifts and other additional or modified features on the buses as well as the capital cost of any special maintenance equipment and any renovations at bus stops and other transit facilities. It also includes any additional administrative and operating costs associated with planning, marketing, schedule changes, service delays, lift maintenance and inspection, personnel and user training, and insurance premiums and claims settlements. The cost of the lifts and related equipment generally accounts for the bulk of the additional capital cost. This cost is fairly predictable and depends primarily on the number of lift-equipped buses in the system. The other costs will depend on the scope of planning, marketing, and training activities; maintenance policies, procedures, capabilities, and workload; the reliability of the lift equipment; the number of platform hours added; and the accident experience of individual transit systems. Most of these costs are not affected by the number of people using the wheelchair lifts. As the demand for accessible bus service increases, however, the cumulative delay caused by frequent deployment of the lifts may require longer run times and extra platform hours of service. Thus far, however, extensive and costly changes in schedules have not been necessary. The average additional operating cost of existing accessible fixed-route bus systems has been around $2,000 annually per lift-equipped bus. The range in cost, however, has been quite large among existing accessible bus systems.

The cost structure of the specialized transportation service alternative includes all of the costs of producing and operating such a service: vehicles, office space and other facilities, labor, fuel, tires, oil and lubricants, parts and supplies, insurance, and overhead. Existing specialized transportation services have reported total costs ranging from under $3 per vehicle-hour to over $23 per vehicle-hour. This wide range is due to large differences in the types and mix of vehicles used, wage rates, and the organizational arrangements for managing and operating these services. A detailed analysis of cost by category indicates that a more likely range in the total cost is $8 to $21 per vehicle-hour

for systems utilizing lift-equipped vans and $10 to $23 per vehicle-hour for systems utilizing small lift-equipped buses.

The cost of a user-side subsidy program consists of the payment of subsidies and the cost of administering the program. Unlike the other two alternatives, funds are not spent to purchase a fixed or specified supply of service. The subsidizing agency, therefore, does not pay for any unused or excess capacity. The total subsidy payment depends directly on the demand for taxi service. It can be controlled by limiting the maximum subsidy per trip, limiting the amount of subsidized travel per eligible individual, raising the discounted taxi fares, and placing tight restrictions on eligiblity. Annual subsidy payments have ranged from under $4,000 to over $900,000. The cost of administering a user-side subsidy program includes the costs of administrative staff, office rental and supplies, promotion and advertising, computer processing, and overhead. These costs generally do not depend on the number of subsidized trips taken under the program. Annually, they have ranged from $18,000 to $75,000. In most cases, they constitute less than 40 percent of the total annual cost of the program.

The cost of teaching a retarded person how to travel by bus has ranged betseen $280 and $1,800. A more typical range is $500 to $700 per individual. This is the cost of initial training. Mobility training programs are usually designed to teach the mentally retarded person how to make a particular trip by bus and not how to travel anywhere in the urban areas by bus. Thus, if the bus route changes, the origin or destination of the trip changes, or the retarded individual needs to learn how to make a new trip, some amount of retraining will usually be necessary. Such additional training will generally be easier and, therefore, less expensive. Retraining usually requires less than one-fourth the time needed for initial training. Therefore, it should cost less than one-fourth as much as the initial training.

With few exceptions, existing applications of each of these approaches have not penetrated their intended markets to any significant extent. Utilization rates have typically been very low. The utilization of accessible bus systems has usually been less than 0.1 lift boardings per scheduled lift-equipped bus per day. Seattle Metro's utilization rate of 0.6 daily lift boardings per scheduled accessible bus in 1980 was by far the highest of any accessible fixed-route bus system. In most cities with an accessible bus system, a small number of lift users have accounted for most of the lift boardings. Eligible persons have used specialized transportation services an average of less than once a month. In fact, average monthly utilization rates greater than 0.5 trips per eligible person have been rare. Normally, fewer than one out of every four eligible persons has even bothered to register for these services. Persons who do register have typically averaged less than five trips a month on the specialized transportation systems. The pattern of limited market penetration and low utilization also applies to most existing user-side subsidy programs. Most programs have been subsidizing less than one trip a month per eligible person. Typically, less than a third of the people eligible for the subsidies have bothered to register with the subsidizing agencies. The average utilization rate of these people has generally been under six subsidized trips a month per registrant. In many programs, less than half of the registrants made at least one subsidized trip in any given month. Concerning the effectiveness of mobility training programs, there is only limited information. These programs have been able to train a high percentage of their clients successfully. However, the percentage of mentally retarded persons who have been trained to travel independently by bus is exceedingly small because of various institutional barriers. Furthermore, there is very little information on how many mobility trained retarded persons continue to use transit upon successful completion of the training program.

The transportation handicapped people who have benefited the most from accessible bus services have been those wheelchair users and semi-ambulatory people who live within one or two blocks of a bus route with lift-equipped buses and who experience relatively little difficulty in getting to and from the bus stops. The social and economic characteristics of lift users have varied considerably, both within and between urban areas where accessible fixed-route bus systems operate. On the other hand, the primary users of specialized transportation services and user-side subsidy programs have been those people who have little or no access to automobiles and who generally cannot afford to travel very often by taxi. Because of the eligibility requirements, frequent users of user-side subsidy programs also generally have difficulty using regular transit services or do not have access to a regular public transit system.

Despite the low use of lift-equipped buses, specialized transportation services, and user-side subsidies, transportation handicapped people appear to believe very strongly in the need for each of these transportation solutions. Wheelchair users and other transportation handicapped people have expressed a strong desire for both accessible fixed-route bus systems and specialized transportation services. It is not clear, however, what their preference would be given a choice between these two alternatives. User-side subsidies are also highly favored, although not quite as much as the other two solutions.

CHAPTER FIVE

FINDINGS: COST-EFFECTIVENESS ANALYSIS

In the previous chapter, the cost and the effectiveness of alternative transportation services for handicapped persons were discussed separately. It was found that the cost of providing accessible transportation services can be considerable for some of the alternatives. It was also found that many of the existing accessible fixed-route bus systems, specialized transportation services, and user-side subsidy programs had not been very effective at attracting large numbers of handicapped riders. However, both cost and degree of effectiveness were found to vary over a wide range for each alternative. In this chapter, the relationship between the two measures is analyzed for each alternative and compared between alternatives.

PREVIOUS RESEARCH ON COST-EFFECTIVENESS

Several studies have been conducted to determine the most cost-effective way of meeting the transportation needs of elderly and handicapped persons. The results of four of these studies are reviewed in this section.

Hartgen and Weiss of the NYSDOT analyzed the cost-effectiveness of modifying conventional buses operating on fixed routes and providing a dial-a-ride system exclusively for elderly and handicapped persons (25). The cost of modifying an existing bus system covered the following items: wheelchair lifts and bus kneeling mechanisms, reserved seating, shelters, extra handrails, space for wheelchairs, wheelchair securement devices, lower signal cords, reupholstered seats, a credit card system for fare payment, and reduced fares. The cost of the separate dial-a-ride system included the cost of vehicles, dispatching, maintenance, operation of the vehicles, kneeling mechanisms, wheelchair lifts and securement devices, extra handrails, reupholstered seats, a credit card system for fare payment, and reduced fares. The effectiveness of each alternative was defined as the increase in trips by elderly and handicapped people resulting from the removal of specific barriers. The researchers developed a mathematical model for determining how many additional trips would be made if certain barriers were removed (24). The model incorporated an index of barrier severity, defined as the product of the average perceived degree of difficulty elderly and handicapped people have with a given barrier and the percentage of elderly and handicapped persons affected by the barrier. It was calibrated with data from a survey of elderly and handicapped people in Albany, New York. The respondents' estimates of additional travel were adjusted downward to account for noncommitment bias. The researchers devised various tactics for removing the various barriers under each alternative and estimated the individual and collective cost-effectiveness of each tactic. A separate analysis was made for able-bodied elderly persons and handicapped people. The results for the latter market segment are given in Table 75.

Table 75. Cost-effectiveness of various tactics for removing transit-related barriers to travel by handicapped persons.

Alternative System/ Tactics	Annual Additional Trips	Annual Cost	Cost per Additional Trip
Bus Modification Option			
1. Lift	17,122	$261,300	$15.26
2. Reserved seating	13,677	1,050	0.08
3. Shelters	12,917	480,000	37.16
4. Extra handrails	11,398	4,020	0.35
5. Wheelchair space, etc.	6,332	72,360	11.43
6. Leave by front	5,066	0	0.00
7. Lower signal cords	4,052	4,020	0.99
8. Reupholster seats	4,052	176,880	43.65
9. Credit card system	4,052	9,802	2.42
10. Reduced fares	1,520	19,604	12.90
Total (all tactics implemented)	80,188	$1,029,036	$12.83
Dial-a-Bus Option[a]			
1. Basic system	77,263	$3,085,070	$39.93
2. Lift mechanism	17,122	10,500	0.61
3. Extra handrails	11,398	1,400	0.12
4. Wheelchair ties, etc.	6,332	1,400	0.22
5. Reupholster seats	4,052	8,925	2.20
6. Credit card system	4,052	9,802	2.42
7. Reduced fares	1,502	19,604	13.05
Total (all tactics implemented)	121,739	$3,136,701	$25.77

[a]Sixty-two vehicles operating 12 hours a day, 365 days a year.

SOURCE: Ref. 25.

The researchers concluded that a program of modifying conventional fixed-route bus systems would be more cost-effective than a specialized transportation service. Although a modified bus system would generate less additional ridership than would a special dial-a-ride system, it would cost considerably less. The basic bus transit system already existed, whereas a specialized transportation service would have to be created. Not included in the computation of accessible bus costs were the costs of lift maintenance, driver and user training, and marketing and promotion. The researchers assumed that the marginal cost of operating an accessible fixed-route transit system would be insignificant.

The results of the study indicated that a large number of moderately and slightly handicapped persons would benefit from several relatively minor and inexpensive modifications to existing transit buses. The analysis revealed several barrier-removal tactics that would significantly increase handicapped ridership on transit systems at relatively little or no cost. The researchers recommended a program of implementing the more cost-effective tactics.

The NYSDOT study found that the addition of wheelchair lifts on conventional transit systems would not be very cost-effective. Their installation alone would not have a significant effect on transit ridership. The researchers concluded that it may be necessary to consider a small specialized transportation service exclusively for wheelchair users and other transportation handicapped persons who would be unable to use an accessible fixed-route bus system.

The Congressional Budget Office (CBO) conducted a cost-effectiveness analysis of three strategies for meeting the transportation needs of transportation handicapped people (19). The first strategy, called the "Transit Plan," was designed to comply with the original DOT Section 504 regulations. Under this plan, the fixed-route bus and rail systems in all urban areas would be made accessible to handicapped people through the addition of wheelchair lifts and other special features. It was assumed that half of the cities with rail systems would choose to provide dial-a-ride van service for wheelchair users and taxi subsidies for other handicapped persons instead of modifying rail transit stations and cars. The second strategy, called the "Taxi Plan," emphasized door-to-door service with lift-equipped vans for wheelchair users. It also included taxi subsidies for less severely handicapped persons and certain modifications of buses on regular fixed routes to accommodate moderately handicapped people. The third strategy, called the "Auto Plan," provided for specially equipped private cars or vans for paraplegics and quadriplegics in addition to all the elements of the "Taxi Plan." The various provisions of the three strategies are detailed in Table 76. An important aspect of these strategies is that each consisted of a package of solutions geared to distinct market segments of the handicapped population.

The CBO reviewed the results of the 1977 UMTA national survey of transportation handicapped people, particularly the estimates of additional trips that would be made if certain transportation solutions were implemented. It also reviewed the utilization of existing accessible transit systems, specialized transportation services, and user-side subsidy programs. The researchers then developed their own estimates of additional trip-making, generally compromising between the UMTA survey estimates and the experience of previous local efforts.

Table 76. Three strategies for serving the transportation needs of handicapped persons analyzed by the Congressional Budget Office.

Strategy	Public Transportation Adaptations	Door-to-Door Services
Transit Plan (DOT Regulations)	Wheelchair lifts and special suspension that lowers the front steps on all new buses Bus routes extended to cover unmodified subway stations Elevators in key stations in half the cities with rail systems At least one car per train on subways and commuter rail systems and half the fleet of streetcars adapted for wheelchairs	Dial-a-ride vans for wheelchair users and taxi subsidies for other handicapped persons in half the cities with rail systems
Taxi Plan	Special suspension that lowers the front steps on all new buses Bus routes extended to cover all subway stations More handholds, priority seating, and seat-before-accelerate rule	Dial-a-ride vans for wheelchair users
Auto Plan	Special suspension that lowers the front steps on all new buses Bus routes extended to cover all subway stations More handholds, priority seating, and seat-before-accelerate rule	Dial-a-ride vans for wheelchair users Low-fare taxi service for severely disabled persons unable to use transit Capital assistance to permanently wheelchair-bound paraplegic and quadriplegic persons for purchase of specially adapted automobiles (with no personal income conditions)

SOURCE: Ref. 19.

The CBO defined the cost-effectiveness of each strategy as the total net public cost per additional trip made under each strategy. Two cost-effectiveness ratios were estimated for each strategy--one for moderately handicapped persons and the other for wheelchair users and other severely disabled persons. The results of the CBO's analysis are given in Table 77.

The CBO concluded that either the "Taxi Plan" or the "Auto Plan" would be more cost-effective than the "Transit Plan" for serving the needs of moderately handicapped persons, even though the "Transit Plan" would benefit more people. The "Taxi Plan," however, might be preferred over the "Auto Plan" because it has a lower total net public cost over the next 30 years.

The CBO estimated that the "Transit Plan" would benefit only 7 percent of all wheelchair users and other handicapped persons who cannot use regular transit services. The "Taxi Plan," on the other hand, would enable 26 percent of the severely handicapped population to travel more often, while the "Auto Plan" would help 30 percent. This accounts for the much greater cost-effectiveness of the latter two strategies over the "Transit Plan." The CBO concluded that the "Auto Plan" would be the most cost-effective strategy if one-time capital expenses are considered. The "Taxi Plan," however, would be slightly more cost-effective than the "Auto Plan" after the one-time capital expenses have been paid.

The CBO study discovered that the maintenance costs of lift-equipped buses and the costs of operating bus service to connect unadapted rail stations are substantial. It rejected the view that retrofitting the existing fixed-route transit systems would be cheaper in the long run. The annual net public cost per additional trip made by both severely and moderately handicapped persons after one-time capital expenses have been paid were estimated to be $7.38, $3.94, and $4.48, respectively, for the transit, taxi, and auto plans. The cost-effectiveness measures computed by the CBO showed that, from a national perspective, the strategies empha-

Table 77. Cost-effectiveness of three strategies for improving the mobility of handicapped people, as determined by the Congressional Budget Office.

Strategy	Number of Moderately Handicapped Persons Able to Travel More	Number of Wheelchair Users and Other Severely Disabled Persons Able to Travel More	Total Net Public Cost (millions of dollars)[a]	Total Net Public Cost per Additional Trip Made by Moderately Handicapped Persons (dollars)[b]	Total Net Public Cost per Additional Trip Made by Wheelchair Users and Other Severely Disabled Persons (dollars)[c]
Transit Plan	638,386	103,585	6,841.4	10.31	38.08
Taxi Plan	537,333	348,157	4,446.1	0.41	7.62
Auto Plan	537,333	404,657	6,364.0	0.41	7.33

[a]Total capital and operating costs incurred over the next 30 years, minus revenue through fares from handicapped passengers. Costs are in 1979 dollars.

[b]Costs allocated among additional trips made by all handicapped persons over the next 30 years.

[c]Capital and operating costs per additional trip over the next 30 years allocated among the additional trips made by severely disabled persons during that period.

SOURCE: Ref. 19.

sizing door-to-door service would have a substantially lower cost per trip than the strategy emphasizing modifications of existing fixed-route bus and rail systems.

The CBO study was significant for two reasons. First, it focused on the severely handicapped market segment, consisting of persons who are physically unable to use regular transit, rather than on the entire transportation handicapped population in determining the cost-effectiveness of alternative solutions. Secondly, it considered strategies consisting of combinations of transportation service options as Table 76 shows. The CBO, however, looked at the problem of meeting the transportation needs of handicapped people from a national perspective. Its findings may not apply to every community.

Smith and Vernmark evaluated five alternative transportation services for elderly and handicapped persons in Dane County and Madison, Wisconsin, including the existing specialized door-to-door transportation service (74). The other four alternatives were an accessible fixed-route bus system, a specialized transportation system serving as a feeder to an accessible fixed-route bus system and as a door-to-door service within the feeder area, a metered or exclusive-ride taxi service, and a shared-ride taxi service.

The researchers defined a number of measures of effectiveness for comparing the five alternatives. The measures included not only the cost per trip, but also travel time, ridership, number of people served, punctuality, impact of severe weather, amount of advance reservation time needed, availability of door-to-door service and driver assistance, quality of the ride, exposure to weather, the amount of walking required to access the service, constraints on capacity, hours of service, restrictions on trip purpose or prioritization of trips, annual total direct costs, annual total direct costs to local government, annual cost to other passengers of delays caused by serving elderly and handicapped passengers, effects on transportation system operators, and effects on other users of public passenger transportation systems. The researchers did not attempt to identify the most cost-effective alternative. Rather, they identified the advantages and disadvantages of each and illustrated the trade-offs between alternatives for certain specific objectives such as minimizing costs or maximizing the number of users.

The two accessible fixed-route bus alternatives had the highest costs per trip. Smith and Vernmark estimated that an accessible bus system alone would cost $17.50 per trip. An accessible bus system served by an accessible specialized feeder system would cost $18.25 per trip in the Madison area. The cost of the existing specialized door-to-door transportation service was $10.11 per trip. The metered taxi alternative was estimated to cost between $9 and $12 per trip, while the shared-ride taxi option was expected to cost the least at $6.30 to $8.40 per trip.

Both taxi alternatives, in addition to their relatively low cost per passenger trip, offered a high level of service. They were highly reliable and available at all hours of the day. Both provided door-to door service with less than an hour's advance notice. The expected travel times by taxi were comparable to those on the existing specialized transportation system and less than the travel times on accessible fixed-route bus systems. The two taxi alternatives were expected to generate and attract the same number of trips as an accessible bus system without a feeder system, but fewer trips than would be generated by the specialized door-to-door transportation system and the accessible bus system with an accessible feeder service.

The researchers noted that, without the two days' advance reservation and the limits on the number of trips, the cost of providing a publicly operated specialized demand-responsive transportation system would be higher than that for an accessible fixed-route bus system. Certain constraints on the supply of specialized transportation service were considered necessary to keep the cost per trip at a reasonable level. These constraints reduce the size of the fleet and increase vehicle productivity.

Compared to a door-to-door service requiring reservations two days in advance, an accessible fixed-route bus system has the advantage of giving elderly and handicapped persons greater flexibility in traveling whenever they desire. However, elderly and handicapped persons had to be physically capable of getting to the bus stops and withstanding the severe winter weather conditions of Wisconsin in order to use an accessible bus system. The travel times on an accessible bus system were another disadvantage. Smith and Vernmark estimated that the average travel time on an accessible bus system would be over twice as long as the time required for trips on the existing specialized door-to-door transportation system.

Barker, Ryden, and Watson evaluated different transportation options for elderly and handicapped people in the Dallas-Fort Worth area (75). Two broad classes of options were considered: fixed-route bus service and paratransit. The various bus options consisted of different combinations of major and minor vehicle modifications with either existing or expanded service areas. The minor modifications were intended for those mobility-impaired persons who would not require a mechanical lift. The major modifications included lifts and wheelchair securement devices for wheelchair users.

Instead of estimating the number of trips that would be generated by each alternative, the researchers estimated the potential number of elderly and handicapped users in order to compute an index of cost-effectiveness. Only the portion of the total cost accruing to the local government or agency was included in the assessment of cost-effectiveness. The federal government's share of the cost was excluded.

Table 78 shows the cost-effectiveness of the six alternatives considered under the bus system option. The existing bus system already served over half of the elderly and handicapped population. By making minor modifications, the existing system could have been made to serve an additional 13 percent at a local cost of $6.28 per additional potential user. With major modifications, the existing system would have been able to serve an additional 20 percent at a local cost of $32.15 per additional potential user. If the existing bus system were simply expanded to cover the entire city, an additional 14 percent of the elderly and handicapped population could be served, but at a local cost of $97.47 per additional potential elderly and handicapped user. This expansion, however, would also bring transit closer to many other people. The annual local cost per additional resident covered by the system would be only $9.79. The researchers estimated that 95 percent of the elderly and handicapped population, or all elderly and handicapped persons who are not confined to their homes, could be served by expanding the bus system city-wide and making the necessary major and minor modifications. This would cost the local government nearly $2.5 million, or $58.57 for every additional elderly and handicapped person having access to the system.

The paratransit options involved taxicab services and included various types of subsidies intended to lower taxicab fares for eligible elderly and handicapped users. The following options were considered: capital funding to purchase equipment for taxi companies, a fare increase for other riders, user-side subsidies, and shared-ride taxi service. None of these options was found to be clearly superior to all others, each having certain advantages as well as disadvantages. No direct comparison was made between the fixed-route bus and taxi service options.

Table 78. Cost-effectiveness of several accessible fixed-route bus options in the Dallas-Fort Worth area.

Bus System Option	Local Additional Annual Match	Elderly and Handicapped Population Serviceable	Percent of Total Elderly and Handicapped Population Serviceable	Annual Local Cost per Additional Elderly and Handicapped Person Serviceable
1. No bus modifications; no service expansion	$ 0	65,100	56	$ 0
2. Minor modifications; no service expansion	$ 93,000	79,900	69	$ 6.28
3. Major modifications; no service expansion	$ 746,000	88,300	76	$32.15
4. No bus modifications; city-wide expansion of service	$1,579,000	81,300	70	$97.47
5. Minor modifications; city-wide expansion of service	$1,670,000	99,900	86	$47.98
6. Major modifications; city-wide expansion of service	$2,472,000	110,400	95[a]	$58.57

[a]The remaining 5 percent of the elderly and handicapped population are house-bound.

SOURCE: Ref. 75.

The researchers recommended a combination of fixed-route bus and paratransit options. The fixed-route bus service with minor modifications was recommended for those elderly and handicapped people who have difficulty walking and climbing steps or who have speech, hearing, or emotional disorders, but who can manage to use transit without lift devices. For severely handicapped persons, private taxicab service was recommended with some means of subsidizing or lowering the cost to handicapped users.

As the above review shows, there has been some agreement as well as disagreement in the results of previous research on the cost-effectiveness of transportation services for handicapped persons. In general, the above studies have tended to question the cost-effectiveness of equipping transit buses with wheelchair lifts. They have generally recommended a combination of minor modifications to existing fixed-route bus systems to accommodate moderately handicapped persons and either door-to-door services utilizing lift-equipped vans or subsidized taxi services to accommodate severely handicapped people. Where the studies tend to differ is in the magnitude of the cost-effectiveness of each alternative. Each study used different assumptions and procedures to estimate costs and potential ridership. As a result, previous research has yielded varying estimates of the cost-effectiveness of alternative transportation services for handicapped people.

COST-EFFECTIVENESS OF EXISTING TRANSPORTATION SERVICES

Data on the costs and utilization of actual transportation services for handicapped people can be used to determine and compare the cost-effectiveness of alternative solutions. An indicator of the cost-effectiveness can be obtained by dividing the cost of providing a transportation service by the number of passenger trips made by handicapped persons. The lower this ratio of cost to ridership, the more cost-effective a particular service becomes. Unfortunately, many specialized transportation services and user-side subsidy programs serve other markets besides handicapped people. Although counts or estimates of the number of handicapped users are sometimes available for these services, the operating costs generally cannot be separated by market segment. Hence, in the tables and discussion that follows, the cost-effectiveness ratios that are cited do not always indicate the average cost of transporting a handicapped person.

Table 79 shows that the cost-effectiveness of accessible fixed-route bus systems in operation in 1980 ranged from $16 per lift boarding in Seattle to nearly $1,300 per lift boarding in Detroit. This wide variation is due to large differences in the number of lift-equipped buses in each system's fleet and in the number of lift users. The total additional cost of operating an accessible bus system depends primarily on the number of lift-equipped buses. As utilization of the lifts increases, this cost is spread over a larger number of riders and the cost per lift boarding decreases. While Seattle Metro and Detroit Department of Transportation had the same number of lift-equipped buses in their respective fleets, Seattle had 77 times as many lift users per day. Thus, Detroit Department of Transportation's cost per lift user was over 80 times as high as Seattle Metro's.

Except for the system in Seattle, the cost per trip of existing accessible fixed-route bus systems has been considerably higher than the cost estimated by previous research. To some extent, this may be due to the fact that most accessible transit systems have been operating lift-equipped buses for only a short time. Many of them were not fully accessible yet in 1980. Lift use may increase over time as more buses in the system become accessible and the transit operators gain experience in deploying and maintaining the lifts. As the lift use increases, the cost per lift boarding will go down. Seattle's cost per lift boarding in 1980 was already within the range estimated by previous research.

The cost-effectiveness of a number of actual specialized transportation services is given in Table 80. In sharp contrast to the accessible bus systems, the range in the cost per passenger trip on specialized systems is much narrower. The least cost-effective of the systems shown, the L-Bus in Atlanta, had approximately the same cost per trip as the most cost-effective accessible bus system.

The cost-effectiveness ratios in Table 80 may be somewhat understated. For example, it is known from the sources of data that the reported costs per trip in Fairfield, Stratford, and Akron do not include vehicle depreciation. This is most likely the case for some of the other systems listed as well. Certain administrative costs are also often excluded from the computation of total operating cost, particularly when the management of the specialized transportation service is integrated with the management of other transit services or social programs.

In his analysis of 30 specialized transportation systems in 18 communities, Einstein attempted to determine the effect of various logistical, operational, and economic and administrative factors on the cost-effectiveness of these services (33). These factors included: size of the service area; fleet size; the market served; weather, climate, and topography; the way in which the service is provided both spatially and temporally; the number of operating hours; type of service; driver assistance; the types of trips served; wage rates; contract rates; the ratio of drivers to other staff; the lead and operating agencies; and the fares. Many of these factors are interrelated, and their interaction tends to mask their respective influence on cost-effectiveness. For this reason, Einstein found no strong correlation between the cost per passenger trip and the following variables: size of the service area; size of the fleet; weather, climate, and topography; number of hours of operation; type of driver assistance; wage rates; and the ratio of drivers to other staff. On the other hand, he did discern a clear relationship between cost-effectiveness and the types of market served, the type of service provided, the types of trips served, the subdivision of the service area, whether or not the service is contracted out, and the type of lead agency. These findings are briefly described below.

The systems that mainly served elderly persons had costs ranging from $1.95 to $4.37 per passenger trip. The average cost per trip was $2.96. On the other hand, those systems that primarily served handicapped persons had a much wider range of costs per trip, going from $3.78 up to $14.42. The average cost per trip for these systems was $8.09.

Many specialized transportation services provide both prescheduled demand-responsive transportation as well as subscription service for periodic trips. However, some systems provide subscription service at only certain times of the day when periodic trips are more likely to be made. According to Einstein's study, these systems tended to be more cost-effective than those that provided sub-

scription service more evenly throughout the day. The former had costs per trip ranging from $1.95 to $11.57, with an average cost of $4.53 per trip, while the latter's cost per trip ranged between $2.17 and $13.69, with an average cost of $6.06 per trip.

Two of the systems included in Table 80 also demonstrate the greater cost-effectiveness of subscription service over demand-responsive service. In Naugatuck Valley, the special dial-a-ride service had a cost-effectiveness ratio of $8.40 per trip, while the subscription service had a cost-effectiveness ratio of only $3.05 per trip. The subscription component of Brockton's DIAL-A-BAT system had an average cost per trip of $1.02 compared to $5.49 for the dial-a-ride component. The greater cost-effectiveness of subscription services comes from the higher vehicle productivities that can be achieved with this type of service. Subscription services usually handle only habitual or regularly scheduled trips that can be grouped into one or a few vehicles.

The types of trips served were highly correlated with the market served and the amount of subscription service provided. Certain types of trips, such as shopping trips and trips to nutrition sites, are more suitable for subscription service and are often made by elderly people. Specialized transportation services that emphasized these types of trips had unit costs ranging between $1.95 and $4.96 per passenger trip. The average cost per trip was $3.75. Specialized transportation systems that handled primarily social-recreation, isolated medical, and other irregular trips not amenable to subscription service and trip grouping were not as cost-effective. Their costs per trip varied from $2.50 to $11.62, with an average cost per trip of $5.87.

Many of the specialized transportation systems analyzed by Einstein covered large service areas. Those that subdivided their service area into zones or modules or that concentrated their vehicles in the inner, more densely developed portion of their service area tended to be more productive and, hence, more cost-effective. The average cost per trip for these systems was $3.25 compared to $8.02 for the other systems.

Table 79. Cost-effectiveness of accessible fixed-route bus systems in 1980.

System	Accessible Buses in Fleet	Daily Lift Boardings	Cost per Lift Boarding
Detroit Department of Transportation	163	0.7	$1,293
Milwaukee County Transit System	250	2.1	661
Bi-State Development Agency (St. Louis)	157	1.0	372
Southeastern Michigan Transportation Authority (Detroit)	111	2.1	293
Southern California Rapid Transit District (Los Angeles)	430	5.0	222
Wichita (Kansas) Metropolitan Transit Authority	31	2.0	202
Santa Monica (California) Municipal Bus Lines	47	1.3	200
Connecticut Transit (Hartford-New Haven-Stamford)	280	12.3	164
Washington (D.C.) Metropolitan Area Transit Authority	150	5.7	146
Palm Beach County (Florida) Transportation Authority	67	3.9	90
Champaign-Urbana (Illinois) Mass Transit District	40	1.7	82
Greater Bridgeport (Connecticut) Transit District	39	2.7	80
Orange County (California) Transit District	175	17.0	57
Municipality of Metropolitan Seattle Transit Department	163	54.0	16

SOURCE: Ref. 47.

Table 80. Cost-effectiveness of existing specialized transportation services.

System	Markets Served	Period Covered by Cost Data	Cost per Passenger Trip
Metropolitan Atlanta Rapid Transit Authority L-Bus (32)	Handicapped	FY 1977	$16.95
Orange County, Calif., Dial-A-Lift (33)	Handicapped, except blind, deaf, and mentally retarded	1979	$14.42
Columbus, Ohio, Project Mainstream (33)	Handicapped	1979	$13.69
Boston, Mass., The RIDE (33)	Handicapped	1979	$11.62
Houston, Tex., METROLIFT (33)	Handicapped, elderly, low income	1979	$11.57
Austin, Tex., Special Transit Service (5)	Handicapped	FY 1978	$10.84
New York City Lower East Side EASYRIDE (36)	Handicapped, elderly	N.A.	$10.83
El Paso, Tex., HandySCAT (50)	Handicapped	N.A.	$ 8.87
Naugatuck Valley, Conn., Transit District (36)	Handicapped, elderly	N.A.	$8.40 dial-a-ride $3.05 subscription
Rochester, N.Y., PERT Lift Line (36)	Handicapped, elderly	N.A.	$ 7.64
Portland, Ore., LIFT (36)	Handicapped, elderly	N.A.	$ 7.31
El Paso, Tex., Project Bravo (50)	Handicapped	N.A.	$ 6.01
Proviso Township, Ill. (36)	Handicapped, elderly	N.A.	$ 5.88
Will County, Ill. (36)	Handicapped, elderly	N.A.	$ 5.50
Brockton, Mass., DIAL-A-BAT (5)	Handicapped, elderly	FY 1978	$ 5.49 dial-a-ride $ 1.02 subscription $ 1.92 combined
Rochester, N.Y., Paratransit Enterprises, Inc. (36)	Handicapped, elderly	N.A.	$ 5.08
Tucson, Ariz. Handi-Car (33)	Handicapped	1979	$ 4.96
Fairfield, Conn., Department on Aging (5)	Elderly, Title XX recipients, wheelchair users	FY 1978	$ 4.80[a]
Bridgeport, Conn., Coordinated System (5)	Elderly, Title XX recipients, wheelchair users	FY 1978	$ 4.75
Pomona Valley, Calif., Senior Citizens and Handicapped Transportation Authority Get About Transportation (5)	Handicapped, elderly	June 1979	$ 4.47
Tucson, Ariz., Special Needs Transportation Service (33)	Handicapped	1979	$ 4.43
Broward County, Fla., Social Service Transportation (33)	Handicapped, elderly, low income	1979	$ 4.37

Table 80. (Continued).

System	Markets Served	Period Covered by Cost Data	Cost per Passenger Trip
Lincoln, Neb., Senior Handivan (33)	Handicapped	1979	$ 4.34
Sacramento, Calif., Paratransit, Inc. (33)	Handicapped, elderly	1979	$ 4.26
Lubbock, Tex., Citizens for Improved Transportation (50)	Handicapped, elderly	N.A.	$ 4.06
Baton Route, La., Special Transportation Service (33)	Handicapped	1979	$ 4.00
Stratford, Conn., Senior Citizen Service (5)	Elderly, Title XX recipients, wheelchair users	FY 1978	$ 3.80[a]
Lowell, Mass., Roadrunner (33)	Handicapped	1979	$ 3.78
Portland, Me., Regional Transportation Program (33)	Handicapped, elderly, low income	1979	$ 3.66
Phoenix, Ariz., Mesa Shared Ride Taxi (33)	Handicapped, elderly, low income	1979	$ 3.50
San Bernardino, Calif. - six dial-a-lift and dial-a-ride systems (33)	Handicapped, elderly, low income	1979	$ 3.46
Syracuse, N.Y., Call-A-Bus (33)	Handicapped, elderly	1979	$ 3.00
Des Moines, Ia., Paratransit (33)	Handicapped, elderly, low income	1979	$ 2.88
Amarillo, Tex., Texas Panhandle Community Action Corporation (50)	Clients of social service agencies	1979	$ 2.65
Corpus Christi, Tex., Elderly and Handicapped Transportation Service (33)	Handicapped, elderly	1979	$ 2.50
Phoenix, Ariz., Dial-A-Ride (33)	Handicapped, elderly	1979	$ 2.17
Akron, Ohio, Special Citizens Area Transit (5)	Handicapped, elderly	Oct. 1978	$ 2.13[a]
Tulsa, Okla., Elderly and Handicapped Transportation Program (33)	Handicapped, elderly	1979	$ 1.95
Spokane, Wash., YMCA Motor Pool (5)	Handicapped, elderly, clients of social service agencies	1977	$ 1.79
Phoenix, Ariz., Red Cross Dial-A-Ride (33)	Handicapped, elderly	1979	$ 1.40

[a]Excludes depreciation.

SOURCE: References indicated by underlined numbers in parentheses.

Specialized transportation services are often operated by a private entity under contract with a public lead agency. Einstein found that these systems tended to have higher costs per trip. Contracted services had an average cost-effectiveness ratio of $7.41 per trip compared to an average of $3.18 per trip for systems operated by the lead agency. Einstein also observed that the contract rate correlated very highly with cost-effectiveness. Systems with the lowest costs per trip tended to have the lowest contract rates and also tended to carry more passengers per hour.

The type of lead agency also seemed to influence the cost-effectiveness. Systems managed by transit agencies tended to have the highest cost per passenger, averaging around $7.11 per trip. The average cost per trip for systems under the control or sponsorship of a city or county government agency was $3.75. Systems run by social service agencies generally have had the lowest costs per passenger trip. There were only two such systems in Einstein's sample. Their average cost was only $2.70 per trip. Some of the systems shown in Table 80 with the lowest costs per trip were also affiliated with social service agencies. These agencies often employ volunteers to drive the vehicles and perform various administrative functions. Their costs, however, tend to be understated. Depreciation and various administrative costs are often excluded from their calculations of total operating costs. Their transportation services also tend to be highly specialized or restricted. Nevertheless, there is reason to believe their transportation operations are generally more cost-effective than those provided by transit and local government agencies.

Table 81 compares the cost-effectiveness of a number of user-side subsidy programs. The cost-effectiveness ratios are generally comparable to those of the specialized transportation services. The range in the cost per trip, however, is much smaller. The most expensive user-side subsidy program--the one in Milwaukee County, Wisconsin--was more cost-effective than many of the specialized transportation services included in Table 80. It should be noted, however, that the cost per trip shown for some of the user-side subsidy programs does not include the cost of administering the program. Administrative costs can increase the average cost per trip by $0.20 to $1.60 (55).

In Portland, Austin, and Akron, taxi user-side subsidy programs were established to supplement the publicly operated specialized transportation services. The lead agency in each case contracted with one or more taxi operators to handle the excess demand for the specialized service. The taxis were often employed to transport semiambulatory persons so that the specialized service's lift-equipped vehicles could be devoted to serving persons using wheelchairs, crutches, canes, or walkers. In Portland, the taxis were also used to handle long distance trips and other single-passenger trips that could not be grouped into a single vehicle. In Akron, Ohio, the taxi user-side subsidy program was used to supplement the specialized transportation service in selected parts of the service area and as a substitute for the specialized service on nights and weekends. In two of the three cases, the user-side subsidy program had a lower cost per trip than the specialized transportation system. The average cost of a trip on the Portland LIFT system was $7.31, while the average cost of a subsidized taxi trip was $5.64. The Austin Special Transit Service had a cost-effectiveness ratio of $10.84 per trip, compared to only $4.50 per trip for the supplemental taxi service. Only in Akron was the cost-effectiveness of the specialized transportation service better than that of the supplemental taxi user-side subsidy program. Akron's SCAT service cost $2.13 per trip, compared to $2.96 for a subsidized taxi trip. The cost-effectiveness ratio for the specialized transportation service, however, does not include depreciation. The cost of the supplemental taxi service was also understated in each case, since the cost of administering the taxi user-side subsidies was included in the cost of operating the specialized transportation service.

At least two cities--Seattle and Milwaukee--have had an accessible fixed-route bus system and a taxi user-side subsidy program in operation at the same time.

Table 79 shows that the accessible fixed-route bus system in Seattle, the most heavily used accessible system in the country, had a cost-effectiveness ratio of $16 per trip in 1980, while Table 81 indicates that the taxi user-side subsidy program had a cost-effectiveness ratio of $4.46, including administrative costs. As was noted in Chapter Four, the two transportation services attracted different segments of the handicapped population. Most of the lift users were confined to wheelchairs and were under 65 years of age. The taxi user-side subsidy users, on the other hand, tended to be elderly people with low incomes. They generally did not have severe physical disabilities.

Mayer, formerly the Managing Director of the Milwaukee County Transit System, made a comparison of the accessible fixed-route bus system and the taxi user-side subsidy program in Milwaukee (76). The regular fixed-route system included 250 lift-equipped buses operating along 17 routes. The

Table 81. Cost-effectiveness of existing user-side subsidy programs.

Site of Program	Period Covered by Cost Data	Cost per Passenger Trip
Milwaukee, Wis. (55)	1980	$7.26
Portland, Ore. (6,36)	Sept.-Nov. 1978	$5.64[a,b]
Austin, Tex. (5)	FY 1978	$4.50[a,b]
Seattle, Wash. (55)	1980	$4.46
Santa Clara County, Calif. (37)	1976	$3.24[b]
Montgomery, Ala. (36)	1979	$3.05
Akron, Ohio (5)	Oct. 1978	$2.96[a,b]
Kansas City, Mo. (41)	May 1977-April 1978	$2.92
Los Angeles Harbor Area (42)	1978/79	$2.83
Sunnyvale, Calif. (37)	FY 1977	$2.30[b]
Palo Alto, Calif. (37)	FY 1977	$2.25[b]
Fremont, Calif. (37)	1976	$2.11
San Leandro, Calif. (37)	1977	$1.85
Kinston, N.C. (36)	1979	$1.47
Lawrence, Mass. (36)	1979	$1.24
Danville, Ill. (36)	1976	$1.22
Lafayette, Calif. (37)	FY 1976	$0.63[b]

[a]The user-side subsidy program in this city supplements the publicly operated specialized transportation service.

[b]Subsidy cost per trip; does not include the administrative cost.

SOURCE: References indicated by the underlined numbers in parentheses.

user-side subsidy program utilized taxi companies as well as a private, for-profit carrier with lift-equipped vans that specialized in the transportation of wheelchair users. People who used wheelchairs, walkers, or crutches and people who were legally blind were eligible for the user-side subsidies. Initially, they paid $1 for a taxi ride plus any amount over $7 on the taximeter. Later, they had to pay a base fare of $1.50 per taxi trip, but the maximum subsidy per trip was raised to $9.50 for wheelchair users and $6.50 for other eligible persons. In a typical month, wheelchair users made only 60 trips on the lift-equipped buses. By contrast, wheelchair users took about 8,250 subsidized taxi trips per month, and the other eligible users made an additional 6,750 trips by taxi. Mayer estimated that the extra cost of maintaining the lifts was approximately $1,000 per lift boarding. Casey estimated that the average cost of transporting a lift user on the accessible bus system in Milwaukee was $661 in 1980 (47). By contrast, the average total public cost of a subsidized taxi trip in Milwaukee was $7.26 in the same year (55). The Milwaukee County Transit System subsequently stopped deploying the lifts on the fixed-route bus system and opted instead for the taxi user-side subsidy program to serve the transportation needs of handicapped people in the Milwaukee County area.

COST-EFFECTIVENESS OF SENSITIVITY ANALYSIS

It is clear from the above discussion that cost-effectiveness is a variable. Both the cost and the utilization of existing transportation systems and programs for handicapped people have varied considerably. Thus, the cost-effectiveness of these services has also been highly variable.

Previous studies have generally produced only a single estimate of the cost-effectiveness of each alternative method of transporting handicapped people. These estimates for any given alternative have differed among the studies, primarily because of differences in the assumptions and methods used to determine costs and ridership. Based on these single estimates of cost-effectiveness, previous researchers determined the most cost-effective solution for either the entire transportation handicapped population or for specific market segments within the transportation handicapped population. Because cost-effectiveness is a variable and not a constant, the results of previous research may not apply to all urban areas or to all situations. For a certain market segment under a specific set of circumstances, a specialized door-to-door transportation system may be the most cost-effective solution. However, for the same market segment under a different set of circumstances, some other solution may be more appropriate. Previous studies have not analyzed the variability of cost-effectiveness to determine under what conditions one alternative is preferable to all others. In NCHRP Project 8-27, an analysis was made to test the sensitivity of cost-effectiveness to changes in a number of variables.

The major difficulty in determining cost-effectiveness lies in estimating the demand for alternative transportation services. This problem stems primarily from an insufficiency of reliable data on the relationship between the amount and level of service provided and the resulting demand for that service by handicapped persons. Rather than make any unverifiable assumptions about this relationship, the demand for alternative transportation services was treated as an exogenous variable in the sensitivity analysis of cost-effectiveness. In other words, the demand was allowed to vary over a wide range without regard to the amount or level of service provided. For the accessible bus alternative, the demand was varied to determine what effect it would have on the cost of operating a fully accessible fixed-route public bus system. For the specialized transportation service alternative, the magnitude and hourly distribution of the demand was used to determine the number of vehicles and vehicle-hours of service needed to handle it under different levels of vehicle productivity. Similarly, for the taxi user-side subsidy alternative, the magnitude and hourly distribution of the demand was used to determine the extra number of taxicabs and cab-hours of service, if any, needed to accommodate the additional taxi ridership. The results of the entire analysis indicated the levels of ridership and other conditions under which one alternative could become more cost-effective than the others.

Accessible Bus Systems

Figure 2 presents the total annual additional cost of operating a fixed-route bus system after it has been made fully accessible to handicapped people in urban areas of 50,000, 200,000, 750,000, and 1,250,000 population. The total additional cost was divided into three levels. The Level I costs represent direct outlays by the transit authority or agency to purchase the wheelchair lifts, to maintain the lifts, and to fund additional expenditures for insurance, marketing and promotion, and driver training. The lifts were amortized over 10 years at a discount rate of 10 percent. The Level II costs represent the cost of delays in the service due to increases in bus stop dwell times to load and unload lift users and to lift malfunctions. They are the sum of the products of the bus operating cost and the delay times of lift boardings and lift malfunctions. These are not out-of-pocket costs, nor do they necessarily translate into direct expenses for the transit operator. They are included in Figure 2 to show how delay costs increase with lift use. At some unknown point, the cumulative delay can become large enough to require schedule revisions and additional platform hours. The cost of this additional service can be allocated to serving the transportation handicapped market. Thus far, additional service costs have not been necessary within the range of daily lift boardings experienced by existing accessible fixed-route bus systems. The Level III costs represent the costs to other bus passengers of delays caused by lift deployment and malfunctioning. Like the Level II costs, they do not represent out-of-pocket expenses for the transit operator. They are included in Figure 2 to illustrate how the level of service could be affected at high levels of lift usage.

As Figure 2 shows, the total annual Level I cost does not vary with lift usage. Instead, Level I costs depend primarily on the number of buses to be equipped with wheelchair lifts and the number of drivers to be specially trained. Both of these numbers are a function of city size. Thus, a fully accessible bus system operating in a city of 50,000 population might incur an additional annual cost of approximately $13,500. This annual Level I cost would increase to $87,000 in a city of 250,000, $240,000 in a city of 750,000, and as much as $1,600,000 in a city of 1,250,000. As daily lift use increases, the annual Level I cost per lift user decreases. For example, if a fully accessible bus system in a metropolitan area of 750,000 transported only 50 lift users a day or 18,250 a year, the Level I cost per trip would be $13.15. If the daily lift

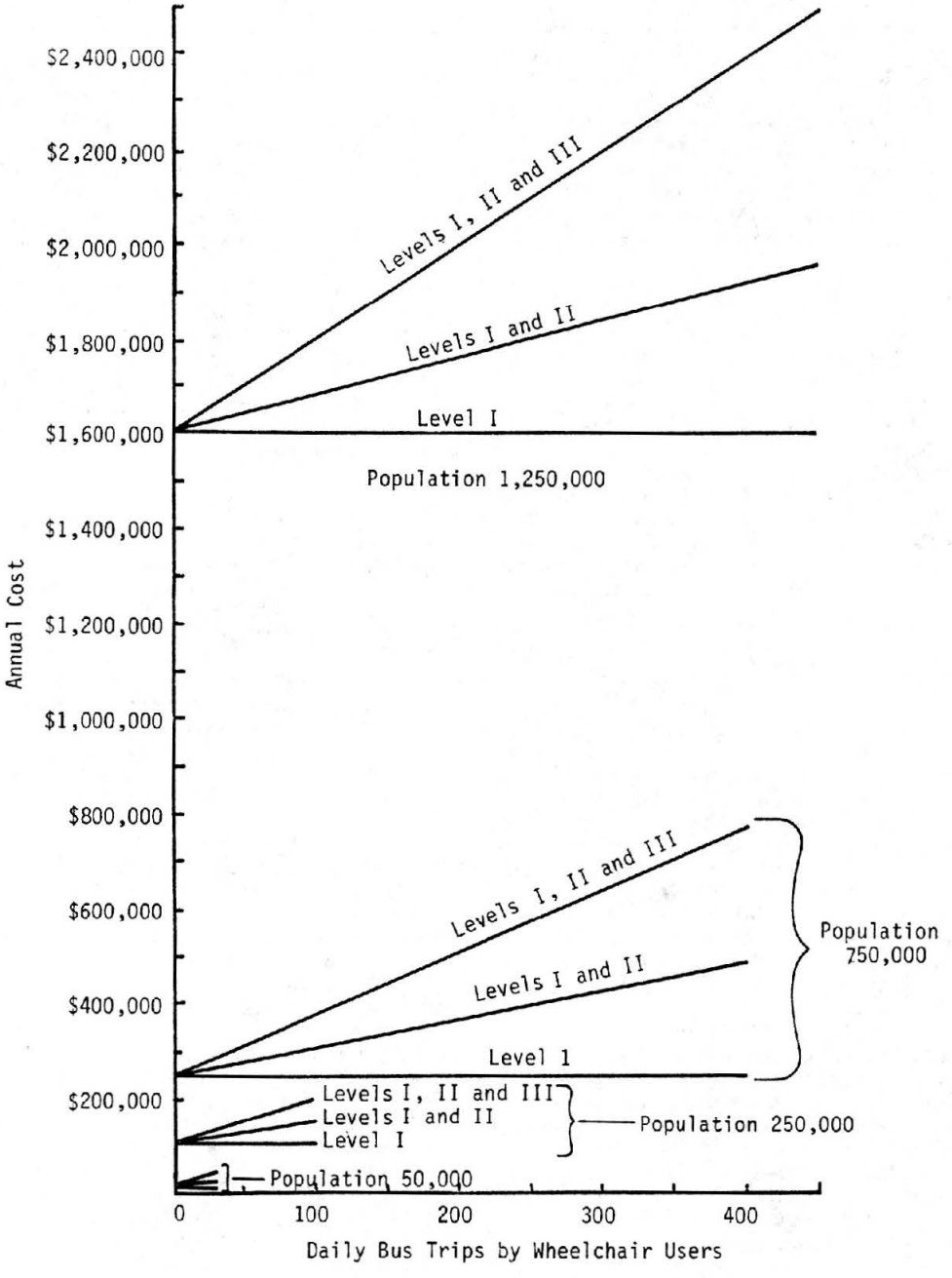


Figure 2. Annual cost of an accessible bus system as a function of population size and daily lift usage.

use increased over time to 200 per day or 73,000 annually, the additional cost per trip would drop to $3.29.

Figure 3 shows more clearly how the cost-effectiveness of an accessible bus system improves as lift utilization increases. The Level I cost per trip was estimated to range from $50 under the low estimate of ridership to $7 under the high estimate. The typical cost per trip was estimated to be around $11 to $12. These cost-effectiveness ratios apply to fully accessible fixed-route bus systems that have been in operation long enough to achieve some stability in the level of lift use. During the period in which a transit system is acquiring lift-equipped buses and implementing accessible bus service, lift utilization can be extremely low and the cost per trip extremely high, as Table 79 attests.

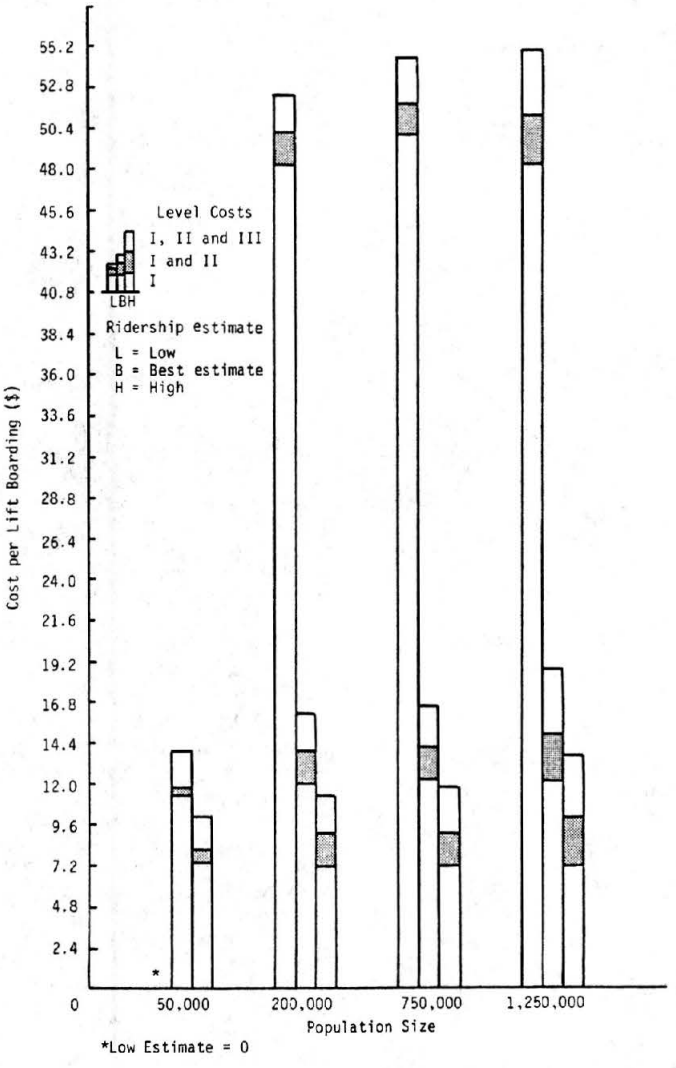


Figure 3. Cost per lift boarding for an accessible bus system as a function of city size and daily lift usage.

Specialized Transportation Services

The cost of providing a specialized door-to-door transportation service depends on a number of factors. One of these is vehicle productivity, which reflects how well the service provider can group trips into as few vehicles as possible. Existing specialized transportation services have achieved productivities from as low as 1.5 trips per vehicle per hour to as high as 12 trips per vehicle per hour. The upper level of vehicle productivity has been reached by some systems that specialize in providing subscription service or in serving groups of people. Typical vehicle productivities for demand-responsive services have been in the range of two to six trips per vehicle-hour. Vehicle productivity, in conjunction with the magnitude and hourly distribution of the demand, determines the number of vehicles and drivers needed during each hour of operation. The total number of vehicle-hours of service provided during the day greatly influences the cost of the service. For a given number of daily vehicle-hours of service, the total cost will depend on hourly wages, the types of vehicles used, and the ability of the service provider under the work rules to tailor the supply of service to the demand. These factors--productivity, magnitude and hourly distribution of demand, hours of operation, hourly wages, flexibility of work rules, and markets served--were varied to determine their effect on the cost-effectiveness of specialized transportation services.

Figure 4 shows the total annual cost of operating a specialized transportation service as a function of daily ridership, the daily distribution of ridership, and vehicle productivity. The total cost includes direct operating costs, indirect costs, and vehicle depreciation. In this figure, the hourly wage was assumed to be $6 and work rules were assumed to be flexible enough to allow the service provider to adjust the number of vehicles in operation during four periods of the day--the morning peak period, the midday period, the evening peak period, and the night period.

As the utilization of the service increases, the importance of high vehicle productivity in limiting the total cost becomes more critical. If the distribution of the demand follows the normal pattern of a morning and evening peak period and specialized service is provided during 11 hours of the day, the

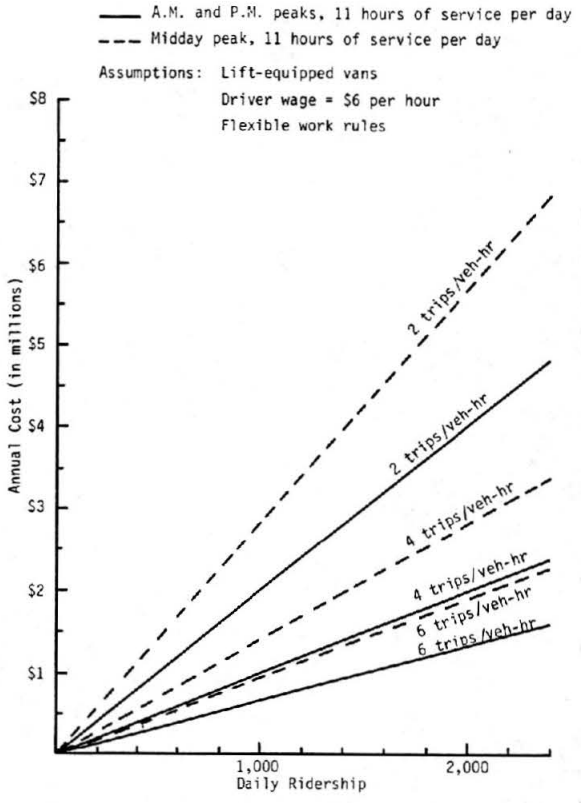


Figure 4. Annual cost of a specialized lift-equipped van service as a function of daily ridership, productivity, and distribution of demand.

total annual cost of serving 400 passengers a day can rise from $0.3 million to $0.8 million as the productivity drops from six trips per vehicle per hour to only two trips per vehicle per hour. If the service is provided 300 days a year, the cost per trip, or cost-effectiveness ratio, rises from $2.38 to $6.77 as the productivity drops from six trips per vehicle per hour to two trips per vehicle per hour. The annual cost of transporting 1,000 passengers a day rises from $0.7 million to over $2.0 million as the productivity drops from six to two trips per vehicle per hour. Thus, as daily ridership increases, the effect of vehicle productivity becomes more pronounced. Total annual costs can be prohibitively high unless efforts are made to increase vehicle productivity. Fortunately, as ridership increases within a given service area, it becomes easier to group two or more trips into a single vehicle.

The distribution of the demand over the day also has an effect on the total cost and, consequently, the cost-effectiveness of a specialized transportation service. Interestingly, it costs about as much to provide 11 hours of service a day to handle a demand that peaks at midday as it does to provide 16 hours of service to handle a demand that follows the more traditional peaking in the morning and early evening, regardless of the vehicle productivity. The demand for specialized door-to-door transportation often peaks during the midday when the service handles primarily nutrition, social service, and medical trips. As Figure 4 shows, under flexible work rules, it requires more vehicle-hours of service to accommodate this pattern of demand than it does to accommodate two peak periods, assuming that the service operates 11 hours a day in both cases.

Figure 5 illustrates the relationships between total annual cost and daily ridership, wage rates, and productivity for a specialized transportation service utilizing lift-equipped vans. The graph is based on 11 hours of service per day and a double-peak distribution of demand. It shows that high wage rates and low vehicle productivities can seriously reduce the cost-effectiveness of a specialized transportation service. If the hourly wage is $8 and the system is unable to handle more than two trips per vehicle per hour, the annual cost of serving 400 passengers a day for 300 days during the year is approximately $1 million or $8.33 per trip. By lowering the hourly wage to $4 and improving vehicle productivity to six trips per vehicle per hour, the same demand can be served at an annual cost of approximately $0.2 million or $1.85 per trip.

The cost of providing a specialized transportation service with lift-equipped vans can be reduced if the service provider has the flexibility to vary the amount of service provided during the day in response to fluctuations in the demand. This is illustrated in Figure 6. If the service provider is prohibited by the work rules from varying the number of vehicles in operation during different periods of the day, the annual cost of transporting 400 passengers a day can range from $0.31 million to $0.95 million depending on the maximum achievable vehicle productivity. If, however, the service provider is able to adjust the amount of service provided according to the highest hourly demand during a given time period, the annual cost can be lowered to a range of $0.29 million to $0.8 million.

The foregoing relationships between costs and daily ridership, wage rates, vehicle productivity, hours of operation, temporal distribution of demand, and variability of the service supply also apply to specialized transportation services that use small lift-equipped buses instead of vans. The costs, however, will be higher by an average factor of 1.15 because of the somewhat higher capital and operating costs of the small buses.

Figure 7 illustrates how the cost-effectiveness can change for typical levels of ridership. It presents the cost per trip as a function of daily ridership, productivity, city size, and the market segments eligible for the service. The bar chart is based on a wage rate of $6 per hour, flexible work rules, 11 hours of service per day, and a double-peak distribution of demand.

Specialized transportation services tend to become more cost-effective as city size increases. In urban places of 25,000, the cost-effectiveness can range from $3.70 per trip to $14.70 per trip depending on the level of ridership, the productivity, and the markets served. The cost per trip in urban areas of 200,000 population can vary between $2.10 and $8.15. In metropolitan areas with populations above 750,000, the cost-effectiveness can range between $2 and $7 per trip. Specialized transportation services can be more cost-effective in larger urban areas because the fixed costs can be spread over a greater number of passengers. The services are also more likely to achieve higher productivities over longer periods of the day than is possible in smaller communities. Offsetting this to some extent is the longer length of trips in large cities. As noted earlier in this chapter, Einstein's study revealed that a service provider can increase the cost-effectiveness of the system by subdividing the service area and concentrating the most vehicle-hours of service in those zones where the density of the demand is greatest.

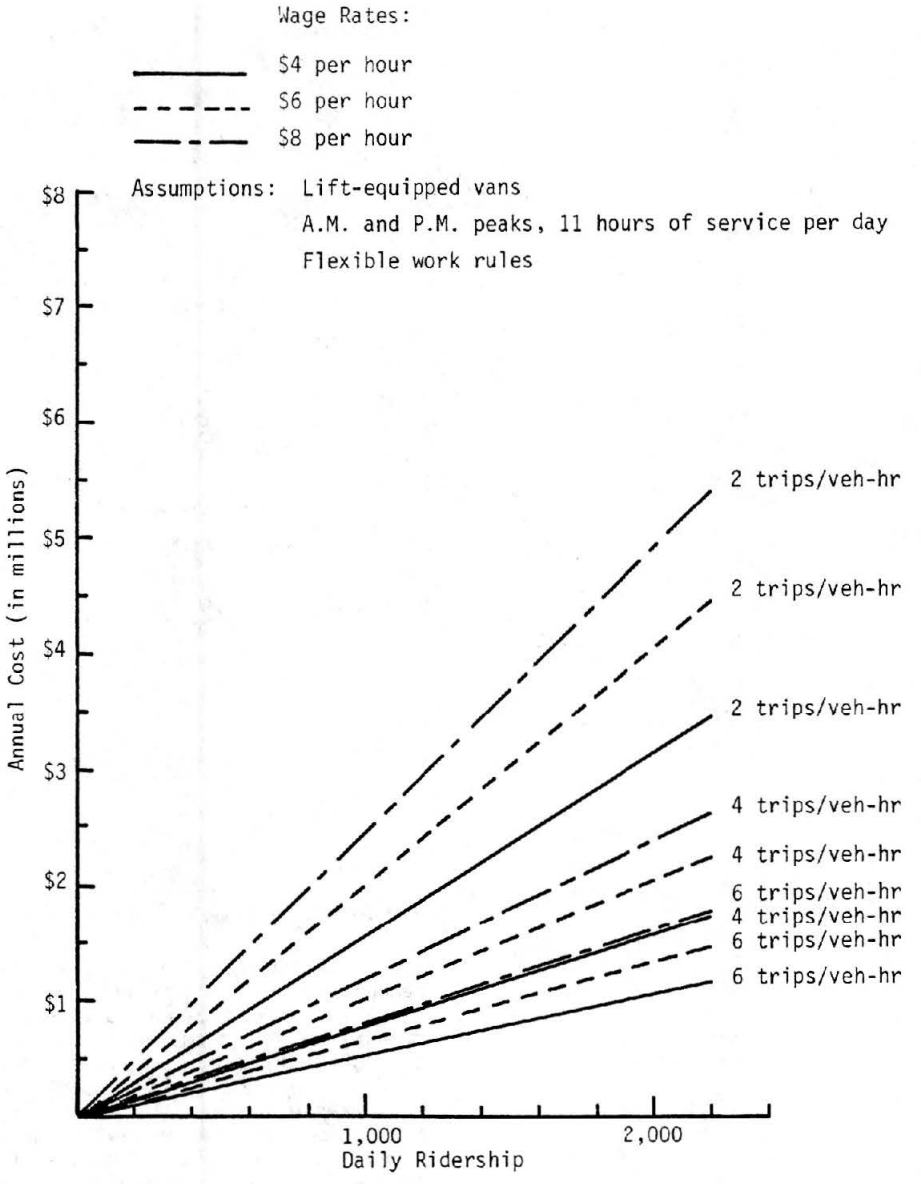


Figure 5. Annual cost of a specialized lift-equipped van service as a function of daily ridership, productivity and wage rate.

Eligibility has a much greater impact on the total cost than it does on the cost-effectiveness. The total annual cost will be much smaller if the service is limited to only the severely handicapped population, consisting of persons who cannot use regular public transportation at all. If eligibility is extended to include moderately handicapped persons or people who can use regular public transportation although with a lot more difficulty than able-bodied people, the total cost can rise considerably, but the cost-effectiveness may not change significantly. For example, in an urbanized area of 750,000 population, the total annual cost of a specialized transportation service for severely handicapped people only can run from $0.15 million to $1.5 million, depending on the average vehicle productivity, the level of the demand, and other factors. If the service is also offered to moderately handicapped people, the total annual cost may range from $0.16 million to $2.5 million. On the other hand, the range in the cost-effectiveness is about the same whether the service is provided for severely transportation handicapped persons only or for both severely and moderately transportation handicapped people. In the former case, the cost per trip may vary from $2.30 to $7. In the latter case, it can vary from $2.10 per trip to $6.90 per trip. A service provider may be able to achieve higher vehicle productivities by expanding the market and thereby improve the cost-effectiveness of the system. However, the marginal cost of serving an additional market may be beyond the collective financial capabilities of the service provider and the other sponsoring agencies.

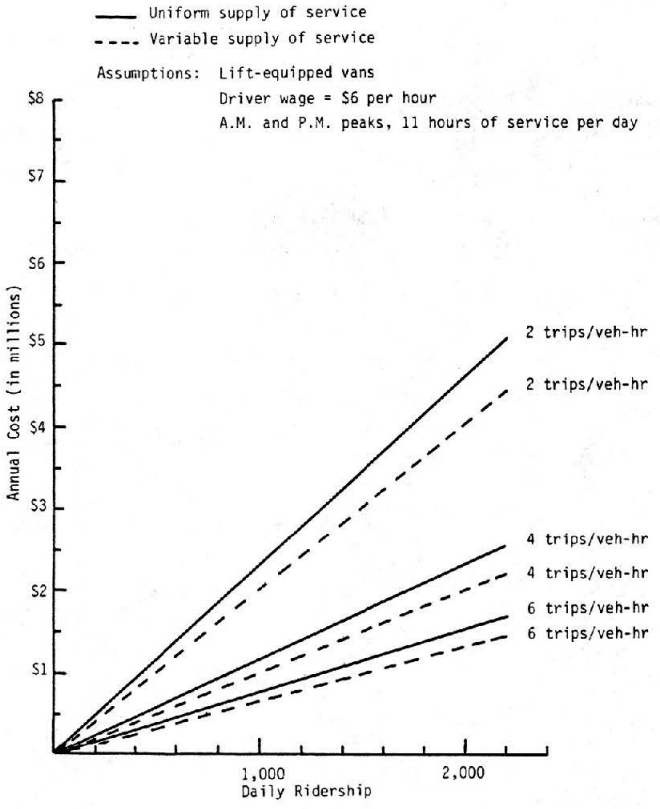


Figure 6. Annual cost of a specialized lift-equipped van service as a function of daily ridership, productivity, and variability of service supply.

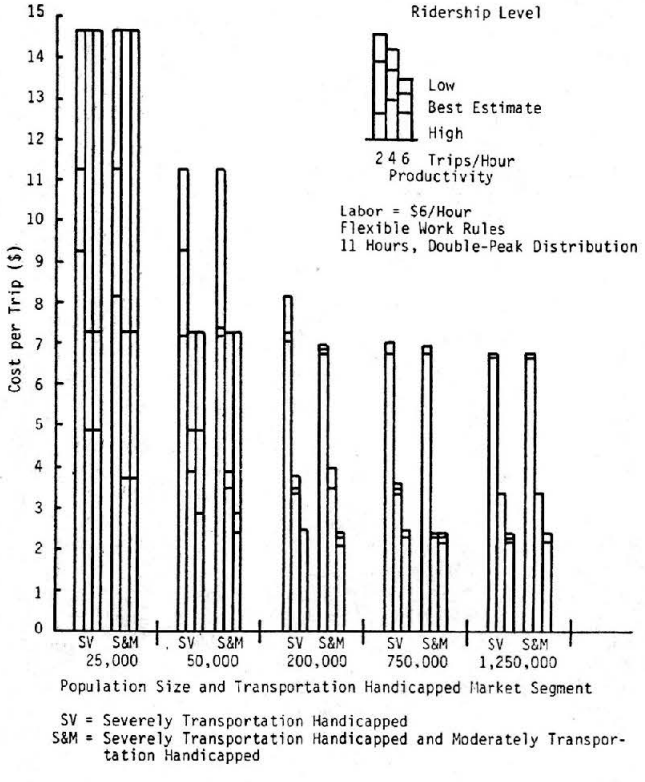


Figure 7. Cost per trip of a specialized lift-equipped van service as a function of market segment, city size, daily ridership, and productivity.

Taxi User-Side Subsidies

The potential of the local taxicab industry to accommodate the transportation needs of transportation handicapped people depends on the supply of taxicab service in the community and the willingness of individual taxi operators to increase the utilization of their fleets, drivers, dispatchers, and other resources to serve this market. A computer simulation model was developed to determine the extra number of taxis and cab-hours of service required to handle the additional ridership that might be generated by a taxi user-side subsidy program. Among the variables considered were the current supply of taxis, the current as well as the potential productivity of the taxi fleet, and the daily ridership and its distribution over the day. The results showed that, in most cases, taxi operators can carry a large number of additional trips without adding extra vehicle-hours of service. For example, in a small community with a taxi fleet of 25 cabs, between 220 and 300 additional taxi trips per day could be accommodated without any increase in service. In a much larger urbanized area with 375 taxicabs, over 2,000 additional daily taxi trips could be handled with the existing supply of service. The increased taxi ridership can be accommodated through greater ridesharing and a reduction in the amount of idle time.

It has been estimated that at least 20 percent of the severely handicapped population are physically unable to ride in taxicabs (8, 53). For these people, it was assumed that the user-side subsidy program would provide lift-equipped vans to be operated by the participating taxi companies under contract with the subsidizing agency.

Figure 8 shows how the cost-effectiveness of a taxi user-side subsidy program with lift-equipped vans can vary by level of subsidy, ridership, city size, and the markets served. The large differences in cost-effectiveness evident in Figure 8 are the result of differences in the cost of providing the supplemental lift-equipped van service. In a community of only 25,000 population, the cost of operating the lift-equipped vans dominates the total cost of the program. The cost per trip can range from $4 to $18, depending on the taxi subsidy level, the markets served, and the ridership. Between 55 percent and 94 percent of the cost is attributable to the lift-equipped van service. In a community of 200,000, the cost per trip ranges between $2 and $5. In this case, the lift-equipped vans account for 30 percent to 75 percent of the cost. The number of people requiring the lift-equipped vans is larger in the latter case and, hence, the fixed cost of the supplemental service can generally be spread over a broader base. The number of people making subsidized taxi trips is also greater. Since the subsidy per taxi trip is generally less than the cost of transporting a handicapped person by lift-equipped van, the larger volume of subsidized taxi trips in the community of 200,000 also tends to lower the average cost per trip. Thus, for a given subsidy per trip, a taxi user-side subsidy program with supplemental lift-equipped van service is more cost-effective in larger cities than in smaller urban areas.

Mobility Training

The cost of training a mentally retarded person to travel by bus does not depend on how often the trainee uses the bus system after successfully completing the training program. Thus, the cost per trip or cost-effectiveness of this alternative improves in direct proportion to the number of times the trained individual travels by bus. If it costs $500 to $700 to train an individual to make a particular trip by bus and the individual uses the bus system only once a month, the cost per trip over a year's time is $20.83 to $29.17 based on 24 one-way bus trips a year. If, however, the mobility trained individual makes a round trip by bus every weekday, the cost per trip over a year's time is between $0.96 and $1.35 based on 520 one-way bus trips a year.

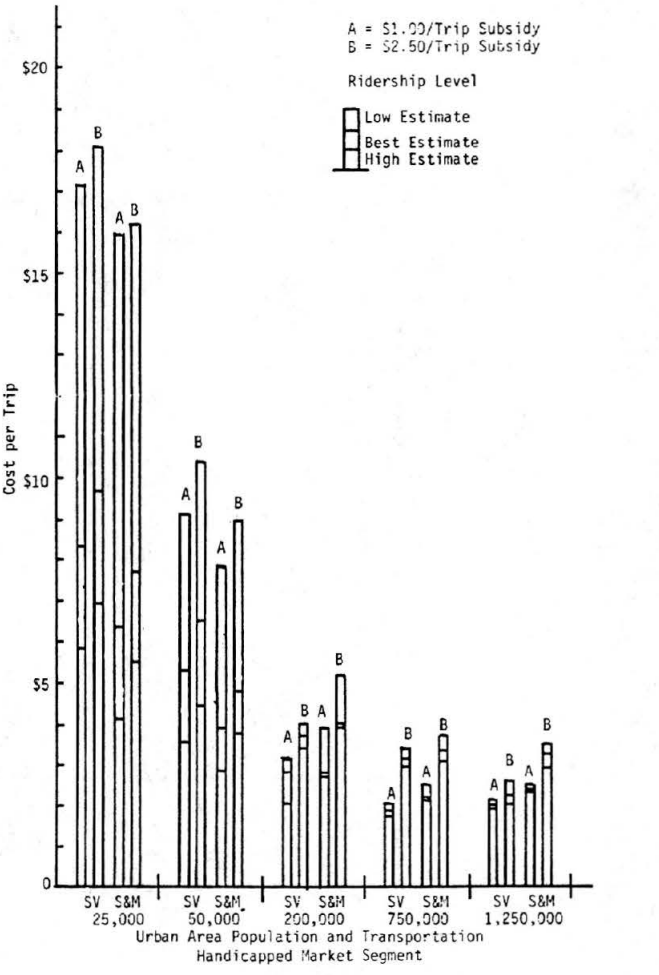


Figure 8. Cost per trip of a taxi-based user-side subsidy program as a function of market segment, city size, subsidy level, and daily ridership.

COMPARISON OF ALTERNATIVES

The results of the preceding sensitivity analysis can be used to determine under what conditions one alternative is more cost-effective than the others. In making such a determination, it must be remembered that some of the alternatives are not necessarily relevant to all market segments of the transportation handicapped population. Accessible fixed-route bus systems, for example, benefit only those handicapped persons who can get to one of the bus stops. The wheelchair lifts on urban transit buses benefit wheelchair users and other people who cannot climb steps. They generally do not help the larger numbers of other handicapped people. Taxicab user-side subsidy programs can serve the vast majority of handicapped people. However, there is a small subgroup of handicapped people, mainly consisting of wheelchair users, who are physically unable to ride in taxicabs. Mobility training programs are specifically designed for either mentally retarded people or blind people. The only alternative among the four considered that could conceivably benefit all handicapped persons is the door-to-door specialized transportation service, under the assumption that there are no restrictions on income, type of disability, location of residence, auto availability, or ability to use transit. Thus, whenever two or more alternatives are compared, the comparison must be made in the context of serving one or more specific market segments.

Accessible Bus Versus Door-to-Door Special Services

Figure 9 compares the annual Level I costs of accessible bus systems with the total annual costs of door-to-door specialized transportation services that use lift-equipped vans. The line labeled "high cost specialized van service" represents a system with the following characteristics:

- A maximum vehicle productivity of 2.0 trips per vehicle-hour.
- Driver wage rate of $8 per hour.
- Sixteen hours of service a day.
- A constant number of vehicles in operation during daylight hours.
- Peak periods of demand in the morning and late afternoon.

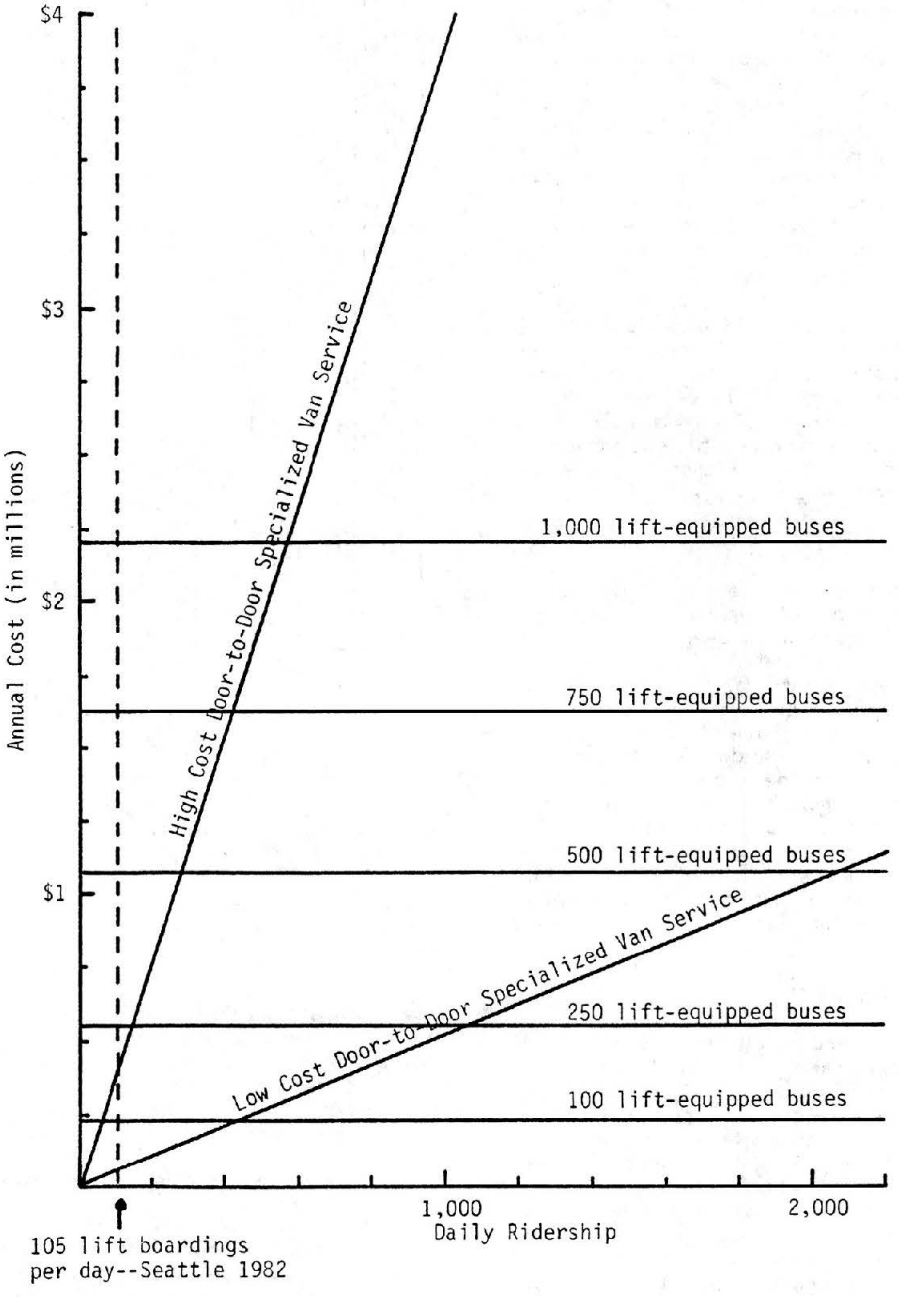


Figure 9. Comparison of cost-effectiveness of accessible bus systems and specialized van services at high levels of ridership.

This was the most expensive specialized van service analyzed in the sensitivity analysis of cost-effectiveness. The line labeled "low cost specialized van service" represents a system with the following characteristics:

- A maximum vehicle productivity of 6.0 trips per vehicle-hour.
- Driver wage rate of $4 per hour.
- Eleven hours of service a day.
- A variable number of vehicles in operation during the day depending on the highest level of demand during certain time periods.
- Peak periods of demand in the morning and late afternoon.

This was the least expensive door-to-door lift-equipped van service considered in the sensitivity analysis. Thus, the two diagonal lines in Figure 9 represent the upper and lower bounds of the annual costs of specialized transportation services for the levels of daily ridership shown. Most existing specialized transportation systems have had costs per trip within this range.

Figure 9 indicates the situations under which one of the alternatives is more cost-effective than the other. In the wedge-shaped area to the left of the "high cost specialized van service" line, specialized lift-equipped van systems will usually be more cost-effective than accessible fixed-route bus systems. Conversely, in the wedge-shaped area below the "low cost specialized van service" line, an accessible fixed-route bus system will usually be more cost-effective than a specialized lift-equipped van service. The large area between the two diagonal lines is a transition zone. Either alternative could be more cost-effective in this area, depending on the characteristics of the specialized transportation service.

The implications of Figure 9 can best be illustrated by an example. Consider a large transit property with 1,000 buses. If all of the buses were equipped with wheelchair lifts, the annual additional cost of operating the system would be approximately $2.2 million. The cost is not influenced by the number of lift boardings, at least at current levels of lift utilization. Thus, as the number of lift boardings increases, the cost per trip goes down. If the 1,000 lift-equipped buses in this example could attract 400 wheelchair users a day, nearly four times the number transported per day by the relatively successful system in Seattle, the cost per trip would be approximately $18, assuming 300 days of operation in a year. To serve these 400 wheelchair users with a high cost, door-to-door, lift-equipped van service would cost around $1.55 million annually. The average cost per trip over a year's time would be approximately $13. In this case, even a high cost specialized transportation service would be more cost-effective than the accessible fixed-route bus system with 1,000 lift-equipped buses. The accessible bus system would have to attract at least 560 wheelchair users a day to be as cost-effective as a high cost specialized transportation service transporting the same daily number of wheelchair users. The level of lift usage corresponds to a lift utilization rate of 0.56 lift boardings per day per lift-equipped bus, well above the rate of 0.33 lift boardings per day per accessible bus achieved in 1980 by the Seattle Metro system, the most successful large transit property accessible bus system to date.

Instead of putting wheelchair lifts on all 1,000 buses, the transit property in the above example could have equipped half of the fleet with lifts. In this case, the 500 buses would have to carry at least 280 wheelchair users a day to be as cost-effective as a high cost door-to-door service and over 2,000 wheelchair users a day to be as cost-effective as a low cost specialized transportation service. At 280 wheelchair users a day, the lift utilization rate would still be 0.56 lift boardings a day per accessible bus.

The sensitivity analysis showed that, as the daily ridership on a specialized transportation service climbs above 200 passengers, the cost per trip tends to oscillate around an average rate with the amplitude of the oscillation decreasing as the ridership increases. The average cost per trip depends on such factors as the maximum vehicle productivity, hourly wage rate, hours of operation, temporal distribution of the demand, and the flexibility of the work rules. A plot of total annual cost versus daily ridership yields virtually a straight line for ridership levels above 200 passengers per day. Below this threshold, such a straight-line relationship is not very accurate. Consequently, Figure 10 was constructed to compare the cost-effectiveness of accessible bus and specialized transportation systems at lower levels of ridership.

Figure 10 shows that an accessible fixed-route bus system with 100 lift-equipped buses would have to attract 46 wheelchair users a day to be as cost-effective as a very costly and unproductive door-to-door, lift-equipped van service. The resulting lift utilization rate of 0.46 lift boardings per day per accessible bus is still above current lift utilization rates but might be attainable. However, a much more cost-effective specialized transportation service could easily be designated to accommodate 46 wheelchair users per day.

A small urban or rural transit system with 20 lift-equipped buses could be more cost-effective than a specialized, door-to-door system if it could attract between 10 and 40 lift users a day. However, it would have to carry at least 78 wheelchair users to be as cost-effective as a highly productive, efficiently operated specialized transportation service with low wage rates.

Only small urban or rural transit systems with 15 or fewer lift-equipped buses are likely to be more cost-effective than a specialized transportation service. Such systems would only have to transport 10 lift users a day to have a lower cost per trip. This corresponds to a lift utilization rate between 0.5 and 1.5 lift boardings per day per lift-equipped bus. A number of small transit systems have been able to achieve lift usage rates within this range.

Accessible Bus Versus Taxicab User-Side Subsidy

In Figure 11, the annual Level I cost of accessible bus systems of different sizes is compared with the annual cost of various taxicab user-side subsidy programs for different levels of daily ridership. Two of the five user-side subsidy programs shown include a supplemental lift-equipped van service for wheelchair users who are physically unable to ride in regular taxicabs. This service was assumed to have the following characteristics:

- A maximum productivity of 2.0 trips per vehicle hour.
- Hourly wages of $6.00 for the drivers.
- Eleven hours of operation per day.
- Peak periods of demand in the morning and late afternoon.
- A variable number of lift-equipped vans in operation during the day depending on the highest level of demand during certain time periods.

Line	Productivity	Wage Rate	Hours of Service	Supply of Service	Demand Distribution
A	2	$8	16	Constant	A.M./P.M. Peak
B	4	$6	16	Variable	A.M./P.M. Peak
C	6	$4	11	Variable	A.M./P.M. Peak

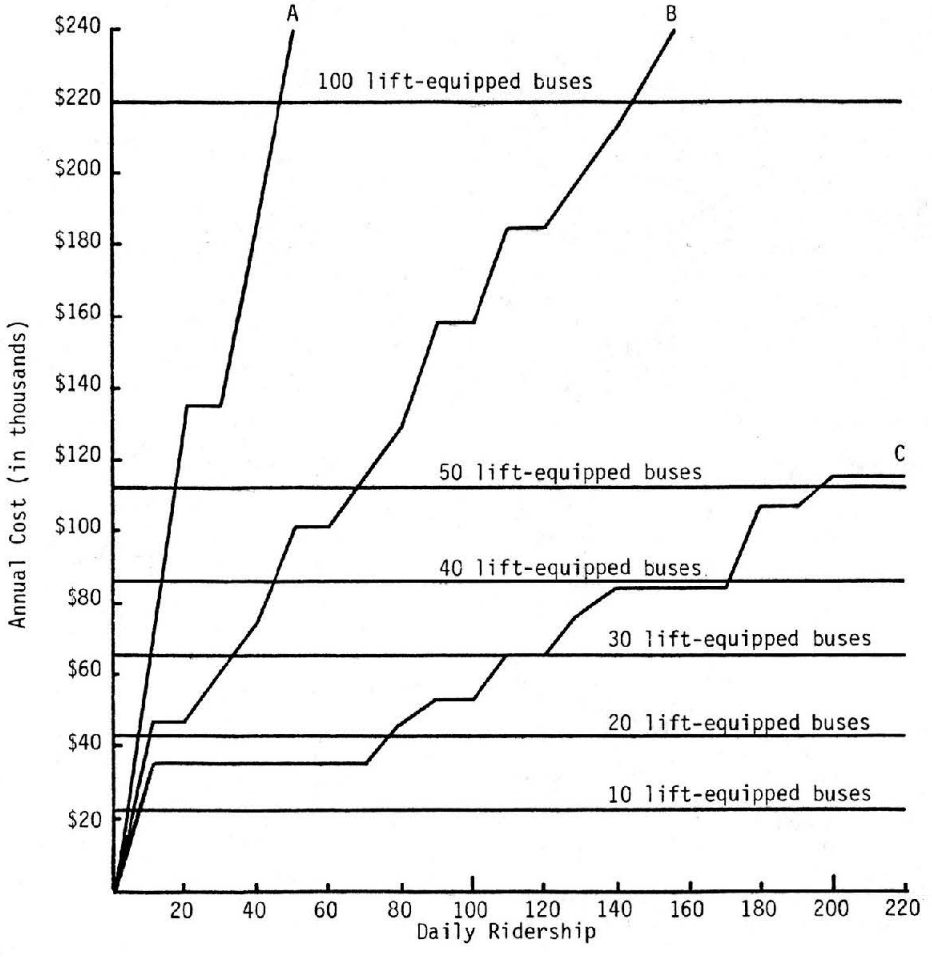


Figure 10. Comparison of cost-effectiveness of accessible bus systems and specialized van services at low levels of ridership.

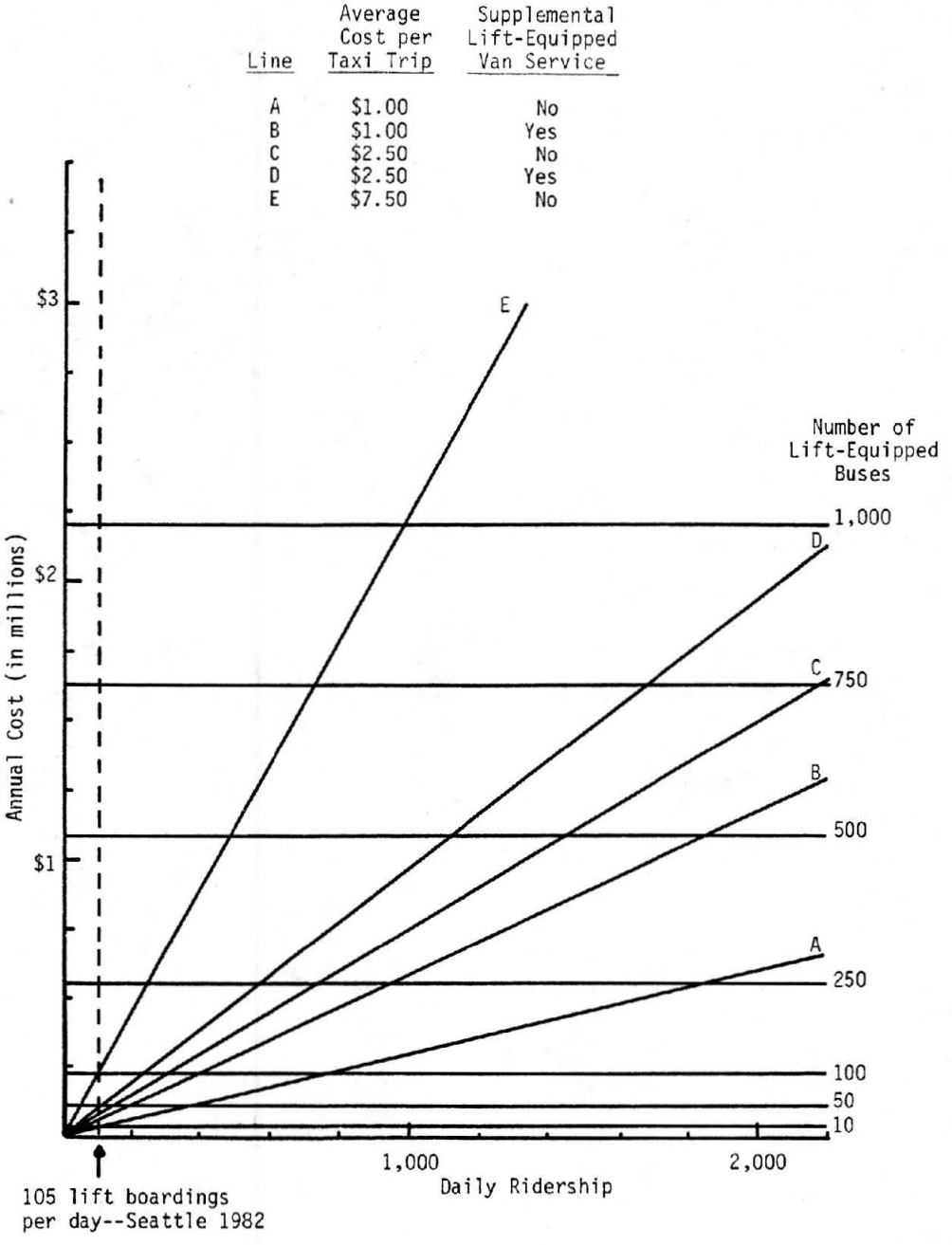


Figure 11. Comparison of cost-effectiveness of accessible bus systems and taxicab user-side subsidy programs.

The results of this comparison are virtually the same as those from the comparison of accessible bus systems and van-based specialized transportation services. Transit properties with more than 100 lift-equipped buses would have to transport a much larger daily number of wheelchair users than existing accessible bus systems have been able to attract in order to be at least as cost-effective as a user-side subsidy program with a relatively high subsidy per trip of $7.50. A small transit system with 50 lift-equipped buses would be as cost-effective as a taxicab user-side subsidy program costing $7.50 per trip if both types of service carried approximately 50 wheelchair users a day. This implies a lift use rate of 1.0 lift boardings per day per accessible bus, a rate much higher than any accessible bus system of this size has been able to achieve to date. Very small transit systems with 20 or fewer lift-equipped buses would most likely be more cost-effective than a user-side subsidy program costing $7.50 per trip. However, the average subsidy per trip in smaller urban areas has generally been under $2.50. A small transit property with 10 lift-equipped buses would have to carry at least 20 wheelchair users a day, or two a day for every accessible bus, to be as cost-effective as a taxicab user-side subsidy program with an average cost of $2.50 per trip and supplemental lift-equipped vans for people who are physically unable to ride in taxis. A few small transit properties have been able to achieve lift use rates greater than 1.0, but the majority have not.

Door-to-Door Special Services Versus Taxi User-Side Subsidy

There is a considerable overlap in the cost-effectiveness of these two alternatives. By comparing Figure 9 with Figure 11, some general conditions can be specified under which one alternative is likely to be more cost-effective than the other.

In general, a high cost taxicab user-side subsidy program is more cost-effective than a high cost, door-to-door specialized van service, regardless of the level of ridership. For example, the annual cost of subsidizing 500 taxi trips a day for 300 days a year at an average cost of $7.50 per trip is $1.125 million. A specialized transportation service with low productivity, high hourly wages, and rigid work rules would cost about $1.95 million annually to transport the same number of handicapped people.

Similarly, a low cost taxicab user-side subsidy program will usually be more cost-effective than a low-cost specialized transportation service. The annual cost of subsidizing 500 taxi trips a day for 300 days a year at an average cost of $1.00 per trip is $150,000. A door-to-door lift-equipped van service with a maximum productivity of 6.0 trips per vehicle-hour, a wage rate of $4 per hour, and the capability of varying the supply of service according to the demand would cost around $260,000 annually to transport the same numbers of handicapped people.

Taxi user-side subsidy programs generally have a lower cost per trip than specialized transportation services, regardless of the demand. In order for a specialized transportation service to have a lower cost per trip than a user-side subsidy program with an average cost of $2.50 per taxi trip plus lift-equipped vans, the specialized service would have to operate under the following conditions:

- Wage rates of $4 per hour.
- Eleven hours of service per day.
- Peaking of ridership in the morning and late afternoon.
- Flexible work rules enabling the service provider to vary the number of vehicles in operation in accordance with the demand.
- A maximum vehicle productivity of at least four trips per vehicle per hour.

If each of the foregoing conditions prevailed and the specialized transportation service was able to achieve an average vehicle productivity of six trips per vehicle per hour, it would have a lower cost per trip than would a user-side subsidy program with an average cost of $1 per taxi trip plus lift-equipped vans. Very few existing specialized transportation systems currently operate under these conditions.

Mobility Training Versus Other Alternatives

Table 82 compares mobility training programs with taxicab user-side subsidy programs and specialized transportation services. It first shows the annual cost of training 200 mentally retarded persons a year at costs of $280, $690, and $1,800 per person. These were the unit costs incurred by three actual programs (56,57). The table then shows what the average cost per trip would have to be to transport each of these 200 mentally retarded persons twice a day for 250 days a year either by taxi or by a specialized transportation service for an annual cost equal to the total cost of training the 200 people. The resulting costs per trip are

Table 82. Comparison of mobility training with other alternatives.

	Cost of Training per Person		
	$280[a]	$690[b]	$1,800[c]
Cost of training 200 monthly retarded persons a year to travel by bus	$56,000	$138,000	$360,000
Average cost per trip to transport 200 mentally retarded persons twice a day for 250 weekdays by taxi or by specialized transportation at an annual cost equal to the annual mobility training cost	$0.56	$1.38	$3.60
Number of mentally retarded persons who could be transported twice a day for 250 weekdays by taxi or by specialized transportation at an annual cost equal to the annual mobility training cost if the cost per trip were:			
$ 1.00	112	276	720
$ 1.50	75	184	480
$ 2.00	56	138	360
$ 2.50	45	110	288
$ 3.00	37	92	240
$ 4.00	28	69	180
$ 5.00	22	55	144
$ 7.50	15	37	96
$10.00	11	28	72

[a]Center in Mental Retardation, California State University at Los Angeles; SOURCE: Ref. 56.

[b]Mobility Training Program, Sacramento, California; SOURCE: Ref. 57.

[c]Wayne County Association for Retarded Citizens, Detroit, Michigan; SOURCE: Ref. 57.

quite low in the case of the $280 per person program and the $690 per person program. Most user-side subsidy programs and specialized transportation services have incurred higher average costs per trip and, therefore, would not be able to match the low costs per trip shown in the table. Table 82 also shows how many mentally retarded persons could be transported twice a day for 250 weekdays a year by taxi or by a specialized transportation service at different costs per trip for an annual cost equal to the total cost of training 200 mentally retarded persons a year to use the bus system. For the lowest cost mobility training program, the number of people in each case is well below 200. For the program costing $690 per person, the number of people is less than 200 in every case except the user-side subsidy program or the specialized transportation service costing $1 per trip. In general, mobility training programs with unit costs similar to those in Los Angeles and Sacramento are highly cost-effective compared to the other alternatives. However, when the cost of training reaches as high as $1,800 per individual, mobility training begins to lose some of its appeal.

SUMMARY

Several previous studies have addressed the question of what is the most cost-effective way of meeting the transportation needs of transportation handicapped people. These studies have generally found one approach to be more cost-effective than all of the other alternatives.

Cost-effectiveness, however, is a variable. The cost-effectiveness of any alternative will vary depending on the interaction of many factors. The cost of transporting handicapped people on existing accessible fixed-route bus systems has ranged from $16 per lift user to over $1,000 per lift user. Existing specialized transportation services have had costs per passenger trip ranging from $1.40 to $16.95. User-side subsidy programs have costs between $1.47 and $7.26 per passenger trip. Because there is some overlap in these ranges of cost-effectiveness ratios, it is possible that a particular alternative may be more cost-effective than the other alternatives under certain conditions and less cost-effective under other circumstances.

A sensitivity analysis of the cost-effectiveness of four transportation alternatives showed that no single alternative is the most cost-effective for all market segments under all situations. However, the analysis did indicate the circumstances for which one alternative is likely to be preferable to all others.

Accessible fixed-route bus systems generally will not be as cost-effective as taxicab user-side subsidy programs and specialized transportation services in serving wheelchair users and other severely handicapped persons who cannot board conventional urban transit buses. Large and medium-sized transit properties would have to transport a much larger number of wheelchair users each day than existing accessible bus systems have been able to attract in order to be at least as cost-effective as the most expensive specialized transportation service or user-side subsidy program. Only small urban or rural transit systems with 15 or fewer lift-equipped buses could be more cost-effective than a specialized transportation service.

There is considerable overlap in the cost-effectiveness of specialized transportation services and taxicab user-side subsidies. In general, however, the most expensive taxicab user-side subsidy programs usually have lower costs per trip than the most expensive specialized transportation services. Likewise, the least expensive user-side subsidy programs tend to have lower costs per trip than most many-to-many specialized transportation systems. In order for a specialized transportation service to be more cost-effective than taxicab user-side subsidies, it would have to have low driver wage rates, a maximum vehicle productivity of at least four trips per vehicle per hour, and the capability to change the number of vehicles in operation during certain periods of the day in response to the demand. Most many-to-many, demand-responsive, specialized transportation services operated by transit authorities or local governments would have difficulty meeting those conditions.

Mobility training appears to be a highly cost-effective way of meeting some of the transportation needs of mentally retarded persons. It will generally cost less to train 200 mentally retarded persons a year in how to use the local bus system to make certain trips than it will cost to transport the 200 mentally retarded persons twice a day for 250 weekdays a year by taxi or by a specialized transportation service. The cost of mobility training can be less than $300 per individual, although costs as high as $1,800 per individual have been incurred. As the cost of mobility training rises above $1,000 per person, it begins to lose some of its appeal.

CHAPTER SIX

INTERPRETATION, APPRAISAL, AND APPLICATION

The cost-effectiveness of any solution to the transportation problems of handicapped people depends on many factors. Therefore, it is not possible to specify a single solution that is the most cost-effective for all market segments under all situations. However, through a sensitivity analysis of the factors that determine or influence cost-effectiveness, it is possible to specify the conditions under which one solution will be more cost-effective than the others. In most cases, it will be necessary for local planners to conduct such an analysis to determine the most cost-effective solutions for their own community. To provide local planners and decision-makers with guidelines to assist them in identifying cost-effective solutions for their own urban areas, a separate volume has been prepared for NCHRP Project 8-27. NCHRP Report 262, "Planning Transportation Services for Handicapped Persons--User's Guide" provides practical guidance on how to perform a cost-effectiveness analysis at the local level.

The material in the User's Guide should assist planners in identifying and evaluating alternative ways of improving the mobility of handicapped persons who have difficulty using regular public transportation services. The intent of the guidelines is to address not only the transportation needs of the entire transportation handicapped population but also the needs of specific market segments.

Determining the more cost-effective ways of meeting the transportation needs of handicapped people at the local level requires a systems analysis approach involving the steps outlined in Figure 12. The general procedure is dependent on the selection of a specific geographical area and the market segments to be served. It includes a cost-effectiveness analysis of alternative ways of serving the transportation needs of these market segments. Although the steps in Figure 12 are portrayed in a linear sequence, there will be opportunities to conduct some of the steps in parallel, and several iterations of parts of the process may be required. Each major step is treated as a separate chapter in the User's Guide.

The worksheets and charts in the User's Guide provide practical guidance on how to perform a cost-effectiveness analysis at the local level. By using the worksheets and procedures contained in the guidelines, planners can estimate the various levels of cost and effectiveness associated with a wide range of transportation options for handicapped people. In addition, the planner or analyst can estimate the use of alternative services by handicapped people. More importantly, the guidelines give planners a means for conducting a sensitivity analysis that permits the evaluation of marginal increases or decreases in services and the determination of the effects these changes will have on utilization as well as on the costs to the agencies that provide the services. A very comprehensive set of alternatives can be generated and evaluated through the procedures outlined. Illustrative example problems are included showing the application of the worksheets and procedures to the solution of typical problems.

Because some urban areas may not have an extensive data base to support transportation planning for handicapped people, the User's Guide contains numerous default values or transferable parameters derived from national and local surveys and other research reported in Chapters Two through Five of the final report. However, it is important for planners to use local knowledge and information whenever possible and to apply it to the worksheets and procedures in the User's Guide.

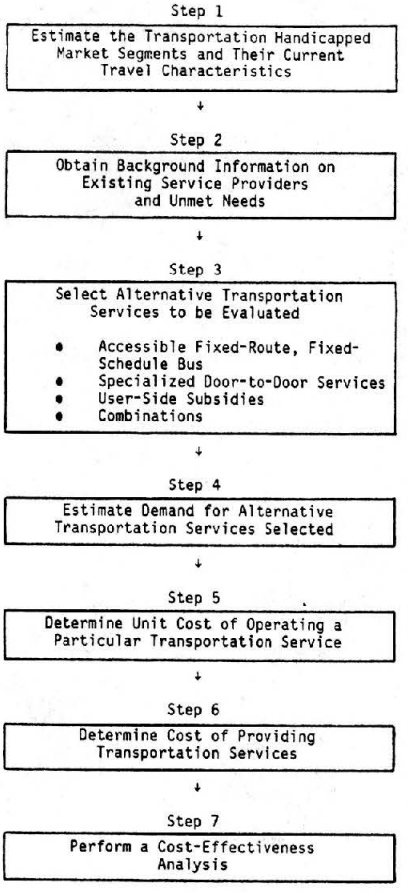


Figure 12. General Steps in a Cost-Effectiveness Analysis.

CHAPTER SEVEN

CONCLUSIONS AND SUGGESTED RESEARCH

CONCLUSIONS

The transportation handicapped population is a small but very diverse segment of the general population. Although only 5 percent of the people 5 years of age or older living in urban places have difficulty using mass transportation services and facilities because of a physical or sensory impairment or health condition, these people constitute a heterogeneous market for public transportation. They differ from each other in many ways including their functional limitations and capabilities, their frequency of travel, their desire and need to travel more often, their financial resources, and their access to private automobiles. In planning for the transportation needs of this small but diverse group of people, it is important to stratify the transportation handicapped population into distinct market segments consisting of people with similar transportation problems and needs.

Three factors seem to be the most important and useful for segmenting the transportation handicapped population. They are:

- Overall ability to use public transportation.
- Type of physical or sensory limitation.
- Access to private automobiles.

It is important to distinguish between transportation handicapped people who can use transit and those who cannot. Nearly half of all transportation handicapped people are able to use existing public transportation services and facilities with only slightly more difficulty than able-bodied people. Only one out of every five transportation handicapped persons cannot use regular public transit at all. The transportation needs of those who can use transit can often be accommodated

through various relatively inexpensive improvements in the vehicles, facilities, and operation of the transit system. Those who cannot use transit, however, will generally require more expensive solutions.

Knowing a person's physical and sensory limitations can indicate to the planner what kinds of problems that individual might have in attempting to travel by public transportation. From this knowledge, the planner can devise alternative solutions that are linked to specific physical problems or barriers and determine the number of people who might benefit from or be affected by each alternative. However, market segmentation by functional disability presents its own problems and limitations. Many handicapped people have more than one functional disability. Wheelchair users provide a classic example. According to UMTA's national survey of transportation handicapped people, some wheelchair users claim that they are able to use public transportation, although with some degree of difficulty. The reason for this seeming anomaly lies in the fact that many of these people only use a wheelchair occasionally. Thus, the wheelchair user market segment could be subdivided into those who require a wheelchair at all times for mobility and those who do not always need a wheelchair for getting around. The former group could be further stratified into two more groups--paraplegics and quadriplegics. Thus, not even wheelchair users constitute a homogeneous group of transportation handicapped people.

The transportation handicapped population does not constitute a captive market for accessible public transportation services. Public transit users have often been divided into two groups--captive riders or those who must rely on public transportation for nearly all of their transportation needs, and choice riders or those who have other means of transportation but choose to use public transit instead. It is clear from this research that if accessible public transportation were available, many transportation handicapped persons would fall into the category of choice riders. According to the UMTA national survey, over 40 percent of transportation handicapped people 15 years of age or older are licensed to drive and over two-thirds of all transportation handicapped people own at least one automobile. One of the major reasons given by handicapped people for not using accessible fixed-route bus systems, specialized transportation services, and user-side subsidies is the availability of private automobile transportation. Determining how many transportation handicapped people have access to an automobile may be one of the best ways of gauging the demand for alternative transportation services for handicapped persons.

Unless barrier-free transportation can significantly lead to greater employment among transportation handicapped people, the potential effectiveness of any transportation solution may be limited. Handicapped people in general travel less than half as often as other people. However, much of this difference in trip-making is because most transportation handicapped people are unemployed. Transportation handicapped people 16 years of age or older make about one-fourth as many work trips as other people in this age group, but they make about 70 percent as many nonwork trips. Although it may be important to narrow and possibly close the 30 percent gap in nonwork travel, this gap, nevertheless, is not as large as commonly believed. Barrier-free transportation, therefore, could have a much greater impact on the mobility of transportation handicapped people if it enabled larger numbers of them to gain employment rather than to enable simply some of them to make a few more nonwork trips. However, it is doubtful that barrier-free transportation services will significantly lower the unemployment rate of transportation handicapped people. Nearly half of all transportation handicapped people are over 65 years of age, and a lack of transportation is not one of the major reasons why many younger handicapped people are unemployed.

Despite the difficulty of measuring it, the latent demand for additional travel by transportation handicapped people appears to be surprisingly low, given the fact that these people generally travel less than half as often as the general public. This may partially explain why many existing accessible fixed-route bus systems, specialized transportation services, and user-side subsidy programs have been underutilized. Previous measures of latent demand indicate that it is only a fraction of the current average rate of trip-making among transportation handicapped people. This implies that transportation handicapped people are already making most of their desired trips. Even if a barrier-free transportation service could satisfy the apparent latent demand, the resulting average daily trip rate would still be much lower than that of the general public.

Barrier-free transportation for handicapped people can be expensive, regardless of how it is provided. The total annual cost of making an existing fixed-route public bus system accessible to handicapped people depends primarily on the number of lift-equipped buses in the fleet. As a rule of thumb, the average additional cost of operating a fixed-route bus system that has been made accessible to handicapped people is approximately $2,000 annually per lift-equipped bus for wheelchair lifts and other vehicle modifications, lift maintenance, driver training, and additional marketing and insurance. Thus, the annual cost for a system with 200 lift-equipped buses would be approximately $400,000. If the system transported an average of one lift user per day per lift-equipped bus--a rate much higher than that achieved by any existing accessible fixed-route bus system--the cost per trip would be approximately $5.50. At the more common rate of 0.1 lift boardings per day per lift-equipped bus, the cost per trip would be close to $55. Specialized transportation systems generally cost between $8 and $23 per vehicle-hour of service, unless the service provider relies heavily on volunteers for drivers. The cost per trip depends on many factors and can easily range from $2 to $15. The average cost of subsidizing a transportation handicapped person's taxi travel can vary from under $1 to over $7 per trip. This cost can add up to hundreds of thousands of dollars annually if the subsidy per trip is high and no limits are placed on each individual's amount of subsidized travel. Thus, regardless of which approach is taken, the provision of transportation services for handicapped persons can entail a considerable amount of public expenditure.

To date, none of the above approaches has had a significant impact on the mobility of most transportation handicapped people. These approaches generally have not caused large numbers of transportation handicapped people to travel more often or to new places. Utilization rates and market penetration in many cases have been extremely low. Many eligible persons often do not even bother to register for specialized transportation services and user-side subsidies. Generally, the people who have benefited the most so far from attempts to provide barrier-free transportation are those who have little or no access to private auto-

mobiles. In most cases, only a few transportation handicapped people have accounted for the majority of trips made on accessible buses, specialized transportation services, and taxis participating in user-side subsidy programs.

The reasons for the limited effectiveness of existing transportation services for handicapped persons are many. As suggested earlier, the latent demand for additional travel appears to be extremely low. There is also the possibility that most existing transportation services, for one reason or another, do not quite meet the needs of many transportation handicapped people. Many handicapped people have access to private automobiles and prefer not to use lift-equipped buses, special door-to-door services, or taxis. Another factor that must also be considered is the inaccessibility of the rest of the environment. Transportation handicapped people face numerous other barriers to mobility besides a lack of accessible transportation. These barriers are architectural, physical, economic, psychological, and institutional. Until these other man-made and natural obstacles are also removed, there is a limit to what any barrier-free transportation system can do to increase the mobility of transportation handicapped people.

Equipping conventional transit buses with wheelchair lifts does not appear to be a particularly cost-effective way of meeting the transportation needs of large numbers of wheelchair users. Under current lift use rates, the incremental cost of making a bus transit system accessible to wheelchair users and other severely handicapped persons who cannot board regular buses is largely independent of the demand for the lifts. Thus, the cost of a wheelchair passenger trip decreases as the number of bus trips made by wheelchair users increases. In order for the cost per lift user to equal that for a high cost specialized transportation service, an accessible fixed-route bus system would have to average close to 0.56 lift boardings per day per lift-equipped bus. The highest lift use rate attained thus far is 0.33 lift boardings per day per lift-equipped bus by Seattle Metro. No other large or medium-sized transit property has come close to Seattle's lift use rate. Moreover, it is questionable whether Seattle Metro's lift use rate will increase any further. Between the autumn of 1980 and the summer of 1982, as Seattle Metro increased the number of lift-equipped buses from 163 to 338, the average number of lift boardings per day per lift-equipped bus dropped slightly from 0.33 to 0.31. Only in small urban areas with bus systems having 15 or fewer buses would an accessible fixed-route bus system have a chance of being as cost-effective as a specialized transportation service.

Some transportation planners and researchers have suggested that it might be more cost-effective to equip only a portion of a bus fleet with lifts and to concentrate the lift-equipped buses on a few carefully selected routes likely to serve the most wheelchair users. The experience of Seattle Metro's accessible bus system supports this idea. A majority of Seattle's lift boardings occurred on a few routes. These routes served residential concentrations of wheelchair users. A partially accessible bus system, however, is not a total solution to the transportation problems of wheelchair users. It will not serve any wheelchair user who cannot get to a bus stop served by lift-equipped buses, nor will it provide access to all possible destinations. Nevertheless, as one element of a larger program of improving the mobility of handicapped people, a partially accessible bus system might be worth considering.

Door-to-door specialized transportation services with either lift-equipped or ramp-equipped vehicles constitute one of the few alternatives that can potentially serve all types of handicapped people for all types of trips. However, the cost-effectiveness of these services varies widely. Many-to-many specialized transportation services (those serving many origins and destinations) tend to have the highest costs per passenger, particularly when they are operated by transit authorities or local governments. Low vehicle productivity and high wage rates account for the high cost per trip. Specialized transportation services can be made more cost-effective by subdividing the service area into zones, by emphasizing subscription service for regularly occurring trips, or by requiring at least two day's notice prior to the trip. Such measures enable service providers to increase the productivity of the vehicles. Some of the most cost-effective specialized transportation services are the many-to-one (many origins to one destination) or many-to-few (many origins to a few destinations) services operated by social service agencies and private, nonprofit organizations. These agencies often use volunteer drivers. In some cases, agency personnel may drive the vehicles as one of their functions. One of the reasons these services are often so cost-effective is because they serve a limited, well-defined group of people and one or a few specific kinds of trips. Thus, the cost-effectiveness of a specialized transportation service will greatly depend on its function. The more general its function, the higher the cost per passenger is likely to be.

If any transportation solution could be singled out as the one likely to be the most cost-effective for many segments of the transportation handicapped population, it would be a taxi-based user-side subsidy program. Private carriers, such as taxicab companies, can be highly cost-effective and have the capacity to accommodate a large number of additional trips by handicapped people without having to expand their fleets or add additional vehicle-hours of service. Special provisions, however, have to be made in a taxi user-side subsidy program to accommodate the small subgroup of handicapped people who are physically unable to ride in taxicabs. Moreover, this alternative may not be feasible in all situations for reasons having nothing to do with cost. For various reasons, local taxi companies may not be willing to participate in a user-side subsidy program. If the local taxi industry consists of numerous individual owner-operators, it may be difficult to organize them into an effective program. In some urban areas, the notion of subsidizing a handicapped person's use of taxicab services--often regarded as a premium form of public transportation--may be politically unpalatable.

Therefore, it is not possible to recommend a single transportation solution that is clearly the most cost-effective for all handicapped people in all situations. The cost-effectiveness of any alternative can vary widely, depending on local conditions and many other factors. A solution that may work well in one community can easily fail in another. Most likely, some combinations of alternative solutions will be required, each focusing on particular needs of particular market segments. For these reasons, a separate document, NCHRP Report 262, was prepared under NCHRP Project 8-27 to provide planners and decision-makers with guidelines on how to evaluate alternative transportation services for handicapped persons and to identify the most cost-effective solutions for their communities.

SUGGESTED RESEARCH

Effects of Level of Service

The current literature does not indicate the relationship between the levels of service of alternative public transportation systems and the utilization of these systems by handicapped people. It is also not clear from the current literature which aspects of level of service have the most effect, if any, on utilization. There is a need for research that would examine the relative importance of various aspects of level of service and whether or not new indicators or measures of levels of service for handicapped people can be developed. Past measures of levels of service for the general public do not appear to be applicable to the various market segments of the handicapped population.

Mode Shift

From the current literature there is little information on where the handicapped ridership is coming from when a new service is introduced. In addition, there is little information on mode preferences of the handicapped population. Research needs to be conducted to ascertain mode preferences and the modes of transportation previously used by handicapped people who are now using a new service.

Latent Demand

More information is needed on the desire of handicapped people to travel more often. This is particularly true for specific market segments. Further research is needed to determine the additional trips that would be made by handicapped people after the introduction of new services with different levels of service or after improvements are made in the levels of service of existing services.

Impact of Specific Barriers to Travel

While there have been some attempts to determine the impact of various kinds of barriers on the mobility of handicapped people, there is little information as to the relative impact of these barriers on specific market segments. Research needs to be conducted that would define the barriers by market segment of the handicapped population and quantify the effect of those barriers as impediments on the travel behavior of handicapped people.

Impact of Transportation and Other Factors on Travel

In this particular research project, evidence collected from interviews with handicapped persons indicated that there are many factors that influence travel behavior other than those related to transportation services. As one individual in a wheelchair indicated, "When I plan a trip, it's like planning on moving the Fifth Army." There are many factors that retard the travel of handicapped people. Some of these factors relate to the characteristics of the destination of the trip, the type of activities to be undertaken at the destination, and the perceived acceptance of handicapped persons by those controlling the activities at the destination of the trip. Research needs to be conducted that would identify and analyze all of the factors that have an impact on the travel of handicapped people. Many of these factors will not be related to the transportation service being used.

Trip Rates on a Comparative Basis

There is not sufficient information in the literature to permit the comparison of trip rates of particular market segments within the handicapped population. Many attempts have been made to segment the handicapped population by type of disability; however, there are numerous types of handicaps and each entails different problems and issues in travel. There is a need for research that would determine the tripmaking characteristics of each market segment so that a comparative analysis could be made and used in the forecasting of travel by handicapped people.

Trip Rates in Rural Areas

Most surveys that have been conducted on the travel of handicapped people have been in areas of 2,500 population or greater. This is particularly true of the statistically designed surveys. While there have been some small studies of an unscientific nature that give some indication of rural trip rates, more sophisticated research is needed to determine rural trip rates and to permit a comparison between urban and rural areas.

Incidence Rates in Rural Areas

Most of the data on the incidence of handicapped people is for urban places of 2,500 population or greater. Research is needed to determine the incidence rates of various types of handicapped people in rural areas.

Psychological Barriers to Travel

Some evidence was found in this research project indicating that psychological barriers may affect travel far more than the levels of service of transportation systems. If this is true, it is questionable whether transportation planners can adequately address all of the transportation needs of the handicapped population simply by providing public transportation services. Research is needed that would attempt to segregate psychological barriers from other barriers that impede the travel of handicapped people.

Productivity Relationships

The productivity of existing transportation services for handicapped persons varies considerably. Unfortunately, there is insufficient statistical information on why these productivities vary so greatly. Research is needed to isolate the specific characteristics of transportation services that have a definite impact on productivity. These various attributes should be quantified so that, in planning transportation services for handicapped people, estimates of productivity can be made with reasonable accuracy.

Defining Market Segments

Unfortunately, transportation handicapped people are not always easy to identify or define. More research is needed on identifying and defining distinct market segments within the transportation handicapped population. Some individuals with similar handicaps may have different problems in using public transportation services. A real contribution could be made to the field of transportation planning if standard definitions of transportation handicapped market segments could be developed. An even greater contribution would be made if these standard definitions would then be used by the various research projects and agencies collecting data on handicapped people. There currently is such a diversity of definitions of handicapped people and market segments that it is difficult to determine the trip-making of particular market segments.

Training Programs

There is evidence indicating that some handicapped persons will not use certain modes of transportation because of a fear that individuals who may have to assist them in their travel will not be adequately trained in moving handicapped people. It appears that, oftentimes, well-intentioned drivers may accidentally bring harm to handicapped persons when trying to assist them because of inadequate training and understanding of the problems surrounding a particular type of handicap. Research needs to be conducted to identify the types of training programs needed and the elements of those programs for training public transportation personnel on the handling of specific types of handicaps. Drivers and assistants must become sensitive to the different needs surrounding particular handicaps. Thus, research needs to be conducted that would develop training programs tailored to specific handicaps.

Development of Materials to Support User's Guide

Further work needs to be conducted that would assist in the implementation of the User's Guide in the transportation planning area. More example problems, student worksheets, and other materials should be developed and packaged for use by individuals using the User's Guide, either in a short course or in a self-training program.

REFERENCES

1. U.S. Department of Transportation, Office of the Secretary, "Nondiscrimination on the Basis of Handicap: Interim Final Rule and Request for Comments." Federal Register, Vol. 46, No. 138 (July 20, 1981).

2. U.S. Congress, House, Surface Transportation Assistance Act of 1982. Pub. L. 97-424, 97th Congress, 2nd session, H.R. 6211, (1982).

3. Lewis, D., "Issues in Transportation of the Elderly and Handicapped." Recording of a presentation made at the 60th Annual Meeting of the Transportation Research Board, Session 195 (January 15, 1981).

4. Bureau of the Census, U.S. Department of Commerce, Disability Data from the National Content Test and the National Content Test Reinterview. National Content Test (1976). Results Memorandum No. 10. (September 9, 1977).

5. Public Technology, Inc., Elderly and Handicapped Transportation: Eight Case Studies. Washington, D.C.: U.S. Department of Transportation (September 1979).

6. Cooper, T., Bloomfield, P., and Flynn, S, "The LIFT: Special Needs Transportation in Portland, Oregon." Final Report, Report No. UMTA-OR-06-004-79-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (August 1979).

7. Crain and Associates, editors, Transportation Problems of the Transportation Handicapped, Volume 1, "The Transportation Handicapped Population, Definition and Counts." Final Report, Report No. UMTA-CA-06-0092-76-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (August 1976).

8. Grey Advertising, Inc., Technical Report of the National Survey of Transportation Handicapped People. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (September 1978).

9. Peat, Marwick, Mitchell & Co., "Elderly and Handicapped Data Collection Study--Dayton Telephone Survey of Transportation Handicapped Persons Design, Administration, and Analysis of Results." Draft Final Report. Washington, D.C.: Peat, Marwick, Mitchell & Co. (June 1981).

10. Crain and Associates, AC Transit Elderly and Handicapped Planning Study: Analysis of Needs and Alternatives. Oakland, California: Alemeda-Contra Costa Transit District (September 1977).

11. Crain, J., and Courington, W., "Incidence Rates and Travel Characteristics of the Transportation Handicapped in Portland, Oregon." Final Report, Report No. UMTA-OR-06-0004-77-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (April 1977).

12. Southeastern Wisconsin Regional Planning Commission, "A Regional Transportation Plan for the Transportation Handicapped in Southeastern Wisconsin: 1978-1982." Planning Report No. 31, Milwaukee, Wisconsin: Southeastern Wisconsin Regional Planning Commission (April 1978).

13. Mark Battle Associates, Inc., and Parsons, Brickerhoff, Quade, & Douglas, Inc., Transportation for Elderly and Handicapped Persons in the Washington Metropolitan Area. Washington, D.C.: Metropolitan Washington Council of Governments (December 1977).

14. Peat, Marwick, Mitchell & Co., "Classification of Transportation Handicaps and the Transportation Handicapped Population." Report No. 1, Phase I, Research on the Transportation Problems of the Transportation Handicapped. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (October 1975).

15. Rosenbloom, S., "Bus Transit Accessibility for the Handicapped in Urban Areas." NCHRP Synthesis of Highway Practice 83, Washington, D.C.: Transportation Research Board (1981).

16. Booz, Allen & Hamilton, Inc. and Synergy Consulting Services, "Planning for the Phase-In of Fixed-Route Accessible Buses: Review of Accessible Transit Services." Interim Report No. 1. Report No. UMTA-IT-09-9010-80-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (January 1980).

17. Levinson, H. S., "Urban Travel Characteristics." Transportation and Traffic Engineering Handbook, Second Edition. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. (1982).

18. Randall, A., Greenhalgh, H., and Samson, E., "Mode of Transportation and Personal Characteristics of Tripmaker." Report No. 9, Nationwide Personal Transportation Study, Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration (November 1973).

19. Congressional Budget Office, Urban Transportation for Handicapped Persons: Alternative Federal Approaches. Washington, D.C.: Congressional Budget Office, Congress of the United States (November 1979).

20. Miller, J. A., "Latent Travel Demands of the Handicapped and Elderly." Transportation Research Record 618, Washington, D.C.: Transportation Research Board, National Academy of Sciences (1976).

21. Michaels, R. M., and Weiler, N. S., Transportation Needs of the Mobility Limited. Evanston, Illinois: Transportation Center, Northwestern University (1974).

22. Abt Associates, Inc., Accessibility of the Metropolitan Washington, D.C., Public Transportation System of the Handicapped and Elderly. Cambridge, Massachusetts: Abt Associates, Inc. (1972).

23. Abt Associates, Inc., Transportation Needs of the Handicapped: Travel Barriers. Cambridge, Massachusetts: Abt Associates, Inc. (1969).

24. Knighton, R. G., and Hartgen, D. T., "Incorporating Barrier Effects in Elderly and Handicapped Non-Work Transit Demand Forecasts." Preliminary Research Report 116, Albany, New York: New York State Department of Transportation (April 1977).

25. Hartgen, D. T., and Weiss, D. L., Cost-Effective Bus Transit Barrier Removal Policies for Elderly and Handicapped." Preliminary Research Report 118, Albany, New York: New York State Department of Transportation (July 1977).

26. Yukubousky, R., and Politano, A., "Latent Travel Demand of the Elderly, Youth, and Low Income Populations." Preliminary Research Report 63, Albany, New York: New York Department of Transportation (August 1974).

27. Falcocchio, J. C., Estimates of Travel Demand for the Disadvantaged: Large Urban Areas. Brooklyn, New York: Polytechnic Institute of New York, Department of Transportation Planning and Engineering (1976).

28. Smith, R. L., and Vernmark, B., Elderly and Handicapped Transportation in Dane County: Survey, Development of Alternatives and Preliminary Demand Analysis. Madison, Wisconsin: University of Wisconsin-Madison, Department of Civil and Environmental Engineering (June 1980).

29. Booz, Allen and Hamilton, Inc., and Synergy Consulting Services, "Planning for the Phase-In of Fixed-Route Accessible Buses." Draft Final Report, Report No. UMTA-IT-09-9010-80-5, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (March 1981).

30. Crain and Associates, editors, Transportation Problems of the Transportation Handicapped, Volume 4, "Transportation Solutions for the Handicapped." Report No. UMTA-CA-06-0092-76-4, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (August 1976).

31. Hooper, K., "A Handbook Describing Low Cost Concepts and Techniques to Make Public Transportation More Available for Visually and Hearing Impaired Persons." Report No. UMTA-DC-06-0349-82-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (April 1982).

32. Paul G., and Casey, R. F., "Atlanta Wheelchair Accessible Bus Study." Final Report, Report No. UMTA-MA-06-0049-78-10, Cambridge, Massachusetts: U.S. Department of Transportation, Transportation Systems Center (August 1978).

33. Einstein, N., "Special Paratransit Service for Elderly and Handicapped Persons: Operational Experience." Final Report, Report No. DOT-I-81-35, Washington, D.C.: U.S. Department of Transportation, Office of the Secretary, Technology Sharing Program (November 1981).

34. Meier, H., Accessible Public Transit: A History and Overview of Accessible Transit Provision in the United States. San Francisco, California: United Cerebral Palsy Association of San Francisco (1981).

35. Public Technology, Inc., Elderly and Handicapped Transportation: Local Government Approaches. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (March 1979).

36. Spear, B. D., et al., "Service and Methods Demonstrations Program Report." Report No. UMTA-MA-06-0049-81-12, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (December 1981).

37. Bloomfield, P., and Flynn, S., "Subsidized Taxi Programs for Elderly and Handicapped Persons in the San Francisco Bay Area." Report No. UMTA-MA-06-0049-77-9, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (September 1977).

38. Koffman, D., "A Taxi Scrip Program in Seattle, Washington." Report No. UMTA-MA-06-0049-82-2, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (June 1982).

39. Lovely, M. E., "The Milwaukee County User-Side Subsidy Program: A Case Study." Report No. UMTA-MA-06-0049-82-4, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (June 1982).

40. Rosenbloom, S., and Warren, D., "Comparison of Two Brokerages: Lessons to be Learned from Houston and Pittsburgh." Transportation Research Record 830, Washington, D.C.: Transportation Research Board (1981) pp. 7-15.

41. Dorosin, E., and Phillips, J., "Share-A-Fare: A User-Side Subsidy Transportation Program for Elderly and Handicapped Persons in Kansas City, Missouri." Report No. UMTA-MA-06-0049-79-11, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (July 1979).

42. Richard, B., "The User-Side Subsidy Taxi Program in the Harbor Area of Los Angeles, California." Report No. UMTA-MA-06-0049-80-9, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (May 1980).

43. Kendall, D., "Comparison of Findings from Projects That Employ User-Side Subsidies for Taxi and Bus Travel." Transportation Research Record 784, Washington, D.C.: Transportation Research Board (1980) pp. 45-52.

44. Starks, J. K., "Mobility Training for the Retarded: An Issue of Public Transit Accessibility." Transportation Research Record 830, Washington, D.C.: Transportation Research Board (1981) pp. 21-25.

45. Laus, M.D., Travel Instruction for the Handicapped. Springfield, Illinois: Charles C. Thomas Publishers (1977).

46. Urbanik, T., II, and Soegard, J. A., Cost-Effectiveness of Accessible Buses in Texas. College Station, Texas: Texas Transportation Institute, Texas State Department of Highways and Public Transportation (1979).

47. Casey, R. F., "The Accessible Fixed-Route Bus Service Experience." Report No. UMTA-MA-06-0049-81-7, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (May 1981).

48. Flynn, S., "Paratransit, Inc., Special Transportation Service in Sacramento. Final Report, Report No. UMTA-MA-06-0049-81-6, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (July 1981).

49. Brail, R. K., Hughes, J. W. and Arthur, C. A., Transportation Services for the Disabled and Elderly. New Brunswick, New Jersey: Rutgers University, Center for Urban Policy Research (1976).

50. Bullard, D. L. and Urbanik, T., "Evaluation of Selected Human Services Transportation Providers in Texas." Report No. UMTA-TX-80-1065-1, College Station, Texas: Texas A&M University, Texas Transportation Institute (August 1980).

51. Cook, A. R., "The DIAL-A-BAT Paratransit Service of Brockton, Massachusetts, Area Transit: Public Transit in Coordinated Human Services Transportation." Report No. UMTA-OK-11-0001-79-5, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (June 1978).

52. U.S. Department of Transportation, Technology Sharing Office, Paratransit: State-of-the-Art Overview. Cambridge, Massachusetts: U.S. Department of Transportation, Transportation Systems Center (September 1981).

53. Karash, K. H., "Analysis of a Taxi-Operated Transportation Service for the Handicapped." Transportation Research Record 618, Washington, D.C.: Transportation Research Board (1976) pp. 25-29.

54. Coons Manufacturing, Inc., Comparative Costs: Ford Super Vans Versus Diamond People Movers. Oswego, Kansas: Coons Manufacturing, Inc. (undated).

55. Spear, B. D., "User-Side Subsidies: Delivering Special-Needs Transportation Through Private Providers." Transportation Research Record 850, Washington, D.C.: Transportation Research Board (1982) pp. 13-18.

56. Starks, J. K., "Two Options for Travel Needs of Mentally Retarded: Implications for Productivity and Cost-Effectiveness." Transportation Research Record 850, Washington, D.C.: Transportation Research Board (1982) pp. 25-31.

57. Starks, J. K., Simpson, C. S., and Menninger, H. S., "The Mobility Training Program of Sacramento: Costs and Methods of Teaching Persons with Mental Retardation to Use Fixed-Route Transit." Draft Paper (1983).

58. Koffman, D., "Lift-Equipped Bus Service in Seattle, Washington." Report No. UMTA-MA-06-0049-81-14, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (March 1982).

59. Multisystems, Inc., "Evaluation of the Palm Beach County Accessible Bus Demonstration." Draft Report, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration and Transportation Systems Center (May 1982).

60. Multisystems, Inc., "Evaluation of the Washington, D.C., Accessible Bus Demonstration." Draft Report, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration and Transportation Systems Center (January 1982).

61. Teixeira, D., Varker, F., and Bowlin, R., "Accessible Bus Service in St. Louis." Final Report, Report No. UMTA-MA-06-0049-80-6, Cambridge, Massachusetts: U.S. Department of Transportation, Transportation Systems Center (February 1980).

62. Edelstein, P., "Evaluation of the EASYRIDE Specialized Transportation Service." Final Report, Report No. UMTA-MA-06-0049-4, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (November 1979).

63. Neumann, L. A., Wojno, J. A., and Juster, R. D., "Integrated Dial-A-Ride and Fixed-Route Transit in Ann Arbor, Michigan." Report No. UMTA-MA-06-1083-77-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (March 1977).

64. Kocur, G., "The Valley Transit District: Specialized Transportation for the Elderly, Handicapped, and Low-Income in the Lower Naugatuck Valley, Connecticut." Report No. UMTA-CT-06-0003-79-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (February 1979).

65. Newman, D. A., and Holoszyc, M., Evaluation of the Rochester, New York, Community Transit Service Demonstration, Volume 1, "Executive Summary." Report No. UMTA-NY-06-0048-81-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (October 1980).

66. Furniss, R. E., "The Westport, Connecticut, Integrated Transit System." Report No. UMTA-CT-06-007-79-1, Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (July 1979).

67. Rosen, S. B., Chase, M. N., and Burnworth, E. S., Planning Factors for Accessible Transportation Services. Alexandria, Virginia: Chase, Rosen & Wallace, Inc. (September 1982).

68. Grey Advertising, Inc., Summary Report of a Survey of Transportation Handicapped Users and Non-Users of Special Transportation Systems in Four Cities. Washington, D.C.: U.S. Department of Transportation, Urban Mass Transportation Administration (December 1980).

69. Spear, B. D., Page, E. A., Slavin, H., and Hendrickson, C., Recent Evidence from UMTA's Service and Methods Demonstration Program Concerning the Travel Behavior of the Elderly and the Handicapped. Cambridge, Massachusetts: U.S. Department of Transportation, Transportation Systems Center (October 1978).

70. Charles River Associates, Inc., User-Side Subsidy Demonstration Project: Montgomery, Alabama. Boston, Massachusetts: Charles River Associates, Inc. (April 1982).

71. Charles River Associates, Inc., "User-Side Subsidy Demonstration Project: Lawrence, Massachusetts." Draft Final Evaluation Report, Boston, Massachusetts: Charles River Associates, Inc. (May 1982).

72. Charles River Associates, Inc., "User-Side Subsidies for Shared-Ride Taxis in Kinston, North Carolina." Report No. UMTA-NC-06-0002-80-1, Cambridge, Massachusetts: U.S. Department of Transportation, Transportation Systems Center (October 1980).

73. Falcocchio, J. C., "Development of Design Standards for Public Transportation Services for the Transportation Handicapped in Large Urban Areas." Transportation Research Record 784, Washington, D.C.: Transportation Research Board (1980) pp. 13-21.

74. Smith, R. L., Jr. and Vernmark, B. Evaluation of Specialized Transportation Systems for the Elderly and Handicapped in Dane County. Madison, Wisconsin: University of Wisconsin-Madison, Department of Civil and Environmental Engineering (June 1981).

75. Barker, W. G., Ryden, T. K., and Watson, F. T., An Analysis of Transit and Paratransit Options for the Elderly and the Handicapped. Arlington, Texas: North Central Texas Council of Governments (January 1978).

76. Mayer, H. M. "Section 504: Local Perspectives." Paper presented at the 61st Annual Meeting of the Transportation Research Board, Washington, D.C. (January 1982).

APPENDIX A

SURVEY OF TRANSIT AND SPECIALIZED TRANSPORTATION SERVICE PROVIDERS

TRANSPORTATION FOR THE HANDICAPPED QUESTIONNAIRE
(FIXED-ROUTE, FIXED-SCHEDULE BUS SERVICE)

1. Please check all the services provided by your operation for transportation of the handicapped.

   a. Wheelchair lifts on the regular fixed-route, fixed-schedule service _____
   b. Specialized door-to-door service for the handicapped _____
   c. Provide financial support to publicly owned social service agencies (e.g. Department of Public Services) _____
   d. Provide financial support to private social service agencies (e.g., Easter Seal Society) _____
   e. Provide financial support through user-side subsidies or other means to taxi companies _____
   f. Other, please describe _____

2. How many transit buses (used in fixed route, fixed-schedule service) do you have in your fleet? _____

3. How many buses do you operate in your regular peak-hour fixed-route, fixed-schedule service? _____

4a. How many of your buses used in fixed-route, fixed-schedule service have special railings, steps, etc. (but are not wheelchair lift equipped) to accommodate handicapped who are not wheelchair bound? _____

   b. Please describe these special features: _____

5. How many of your buses used in fixed-route, fixed-schedule service are wheelchair lift equipped? _____

6. If all buses used in fixed-route, fixed-schedule service are not wheelchair lift equipped, what criteria do you utilize for deployment of the wheelchair lift equipped vehicles? _____

7. Describe any special provisions for the handling of transfers on the fixed-route, fixed-schedule buses for the handicapped who are wheelchair bound? _____

8. How many transfers for the handicapped who are wheelchair bound occur on a typical day? _____

9. What percentage of your bus stops have you made provisions for:

   Sight impaired _____ %
   Hearing impaired _____ %
   Walking impaired (but not wheelchair bound) _____ %
   Wheelchair bound _____ %

10. What are your fixed-route, fixed-schedule bus system operating statistics for a typical weekday?

   a. Bus-miles for total system _____
   b. Bus-hours for total system _____
   c. Bus-miles (wheelchair lift equipped vehicles) _____
   d. Bus-hours (wheelchair lift equipped vehicles) _____
   e. Revenue passenger trips (not including transfers) _____
   f. Number of Transfers _____
   g. Number of wheelchair bound handicapped trips per day _____
   h. Number of non-wheelchair bound handicapped trips using system per day _____
   i. Percent of total system cost represented by fare box revenue _____

11. What percentage of the land area within your operating authority is covered by regular fixed-route, fixed-schedule bus service? _____ %
    (sq. miles)

12. What percentage of the population within your operating authority is covered by regular fixed-route, fixed-schedule bus service? _____ % (population)

13. What are typical costs of your fixed-route, fixed-schedule bus services?

    a. Total system operating cost/mile _____

    b. Bus driver wage rate $_____/hr. + $_____/hr. fringe = _____

14. What is your estimated cost per year per bus for maintenance of a wheelchair lift on the fixed-route, fixed-schedule bus system? _____

15. If the provision of handicapped transportation becomes solely a local option, please check which options your community will most likely undertake to provide these services.

    a. All fixed-route, fixed-schedule buses made wheelchair accessible, no specialized door-to-door services provided _____

    b. Part of the fixed-route, fixed-schedule buses made wheelchair accessible, no specialized door-to-door services provided _____

    c. Part of the fixed-route, fixed-schedule buses made wheelchair accessible, and specialized door-to-door services provided _____

    d. All fixed-route, fixed-schedule buses modified with special railings, steps, etc. to accommodate other handicapped, no wheelchair equipped buses, no specialized door-to-door services provided _____

    e. Part of the fixed-route, fixed-schedule buses modified with special railings, steps, etc. to accommodate other handicapped, no wheelchair equipped buses, and specialized door-to-door services provided _____

    f. Provide financial support to publicly owned social service agencies for transportation of the handicapped (e.g. Department of Public Services) _____

    g. Provide financial support to private social service agencies (e.g., Easter Seal Society) for transportation of the handicapped _____

    h. Provide financial support through user-side subsidies or other means to taxi companies for transportation of the handicapped _____

    i. Rely on public social service agencies for public transportation of the handicapped without providing funding _____

    j. Rely on private providers for transportation of the handicapped without providing funding _____

    k. Nothing _____

    l. Other, please describe _____

16. What is your personal opinion of providing transportation services to the handicapped?

_____

_____

_____

_____

_____

We might need some clarification of your responses. Would you please provide your name, address, and phone number in case we need to contact you?

_____

_____

_____

_____

_____

Please return this questionnaire and direct any questions to:

Ms. Leanne Cox
Transportation Center
University of Tennessee
Knoxville, TN 37996
(615)974-5255

TRANSPORTATION FOR THE HANDICAPPED QUESTIONNAIRE
(SPECIALIZED DOOR-TO-DOOR SERVICE)

1. Please check all trip purposes eligible for your specialized door-to-door service.

   a. Work/school _____
   b. Medical _____
   c. Shopping _____
   d. Personal business _____
   e. Recreation _____
   f. Congregate meals _____
   g. Other, please describe _____

   _____

2. How would you describe the specialized door-to-door system relative to the origins and destinations it serves?

   a. Many-to-many _____
   b. Many to few _____
   c. Route deviation _____
   d. Subscription only _____
   e. Other, please describe _____

   _____

3. Please describe the elibility requirements for using your specialized door-to-door service. _____

   _____

   _____

4. What is the average advance reservation time for pickup for the specialized door-to-door system?

   a. On call (no reservation time required) _____
   b. ½ day or less _____
   c. 24 hours (1 day) _____
   d. 48 hours (2 days) _____
   e. Other, please describe _____

   _____

5. For your specialized door-to-door service, what is the typical elapsed time from call to pick-up for the return trip?

   a. 0-19 minutes _____
   b. 20-39 minutes _____
   c. 40-59 minutes _____
   d. 1-2 hours _____
   e. Picked up only at pre-arranged times _____
   f. Other, please describe _____

   _____

6. How many vehicles do you operate in your specialized door-to-door service? _____

7. How many of your vehicles used in specialized door-to-door service are equipped to load wheelchair bound passengers? _____

8. In how many of your vehicles used in specialized door-to-door service do you provide non-driving attendants for assisting the handicapped? _____

9. Do you provide any special training for the drivers of the specialized door-to-door service? YES_____ NO_____

10. Are the vehicles used in the specialized door-to-door system 2-way radio-equipped? YES_____ NO _____

11. What are the specialized door-to-door service operational statistics fora typical weekday?

    a. Vehicle-miles for total system _____
    b. Vehicle-hours for total system _____
    c. Vehicle-miles (wheelchair lift equipped vehicles) _____
    d. Vehicle-hours (wheelchair lift equipped vehicles) _____
    e. Revenue passenger trips (not including transfers) _____
    f. Number of Transfers _____
    g. Number of wheelchair bound handicapped using trips per day _____
    h. Number of non-wheelchair bound handicapped _____
    i. Percent of total system cost represented by fare box revenue _____

12. What percentage of the land area within your operating authority is covered by your specialized door-to-door service? _____ % (sq. miles)

13. What percentage of the population within your operating authority is covered by your specialized door-to-door service? _____ % (population)

14. What are typical costs of your specialized door-to-door service?

    Total system operating cost/mile _____
    Bus driver wage rate $_____/hr + $_____/hr. fringe = _____

15. What is your estimated cost per year per vehicle for maintenance of a wheelchair lift on the specialized door-to-door system? _____

16. What is your personal opinion of providing transportation services to the handicapped? _____

_____

_____

_____

_____

_____

We might need some clarification of your responses. Would you please provide your name, address, and phone number in case we need to contact you?

_____

_____

_____

_____

_____

Please return this questionnaire and direct any questions to:

Ms. Leanne Cox
Transportation Center
University of Tennessee
Knoxville, TN 37996
(615)974-5255

APPENDIX B

MAIL SURVEY OF TRANSPORTATION HANDICAPPED PERSONS

Respondent
Instructions for Completing
This Questionnaire

Dear Respondent:

We appreciate you taking some time to complete the enclosed questionnaire. This questionnaire should not take long to complete and the information you provide will be of great benefit to those concerned with improving transportation for the disabled.

The information you provide will be used in a nationwide study of transportation needs of the disabled. This questionnaire is designed to collect information concerning your travel and your feelings about several transportation related issues. Of course, any responses you offer will be held in strict confidence.

We ask that you do the best that you can in completing all the questions. Please feel free to place written comments beside any responses that you want to clarify. In addition, be assured that any help that you can provide will be greatly appreciated.

If you have any problems or questions, please discuss them with the person that asked you to complete this questionnaire. They will be able to contact the study team who will be happy to supply you with any additional information.

Thank you in advance for your cooperation.

Sincerely yours,

K. W. Heathington, Ph.D., P.E.
Director

KWH:ks
D-CP

Enclosure

1. Physical Problems

Thinking about your general health condition, how much difficulty do you have doing each of the following? Please circle a number from 1 (can do with no difficulty) to 5 (cannot do at all).

How much difficulty do you have:

	Can do With No Difficulty	Can do With a Little Difficulty	Can do With Difficulty	Can do With Much Difficulty	Cannot do at All
WALKING?	1	2	3	4	5
GOING UP AND DOWN STEPS?	1	2	3	4	5
STANDING FOR MORE THAN A FEW MINUTES?	1	2	3	4	5
USING ONE OR BOTH ARMS?	1	2	3	4	5
SEEING EVEN WITH GLASSES?	1	2	3	4	5
HEARING EVEN WITH A HEARING AID?	1	2	3	4	5
SPEAKING?	1	2	3	4	5
SITTING IN A REGULAR CHAIR?	1	2	3	4	5
GETTING UP FROM A REGULAR CHAIR?	1	2	3	4	5
BENDING OVER TO PICK UP SOMETHING?	1	2	3	4	5
LIFTING SOMETHING THAT WEIGHS 10 POUNDS	1	2	3	4	5
HOLDING ON TO SOMETHING WITH YOUR HANDS?	1	2	3	4	5
REACHING FOR SOMETHING ABOVE YOUR HEAD?	1	2	3	4	5

2. Do you use any of the following aids? Please put an X in front of all of the ones that you use.

_____ Wheelchair
_____ Seeing Eye Dog or Guide Dog
_____ Personal Escort
_____ Artificial Leg or Foot
_____ Artificial Arm
_____ Leg Brace
_____ Neck Brace
_____ Arm Brace
_____ Back Brace
_____ Walker
_____ Cane for Support
_____ Cane for Blindness
_____ Crutches
_____ Teletype or TTY machine hooked up to your phone
_____ Other (please specify) _____
_____ I do not use any of these aids

3. Difficulty in Travel

Thinking about your general health condition, how much difficulty do you have in trying to do each of the following? Please circle a number from 1 (can do with no difficulty) to 5 (cannot do at all).

	Can do With no Difficulty	Can do with a Little Difficulty	Can do With Difficulty	Can do With Much Difficulty	Cannot do at All
Driving a car not specially equipped for a disabled driver?	1	2	3	4	5
Driving a car specially equipped for a disabled driver?	1	2	3	4	5
Riding in a Bus?	1	2	3	4	5
Riding in a Car?	1	2	3	4	5
Riding in a Taxi?	1	2	3	4	5
Riding in an Airplane?	1	2	3	4	5
Riding in a Train?	1	2	3	4	5

4. How often do you go out without another person going with you? (check one)

_____ at least 5 days a week

_____ 3 or 4 days a week

_____ once or twice a week

_____ one to three times a month

_____ less than once a month

_____ never

5. Your Travel During the Last 7 Days Only

A. Please circle the number of trips you made during the past 7 days in a PRIVATELY OWNED CAR. Remember, going to a place counts as one trip and returning from it counts as a separate trip.

	Number of Trips										
To and From Work?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Shopping?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From School?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Doctor, Hospital or Clinic?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From any other place?	0	1	2	3	4	5	6	7	8	9	10 or more

B. Please circle the number of trips you made during the past 7 days on the LOCAL PUBLIC BUS. Remember, going to a place counts as one trip and returning from it counts as a separate trip.

	Number of Trips										
To and From Work?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Shopping?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From School?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Doctor, Hospital or Clinic?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From any other place?	0	1	2	3	4	5	6	7	8	9	10 or more

C. Please circle the number of trips you made during the past 7 days in a TAXI. Remember, going to a place counts as one trip and returning from it counts as a separate trip.

	Number of Trips										
To and From Work?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Shopping?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From School?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Doctor, Hospital or Clinic?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From any other place?	0	1	2	3	4	5	6	7	8	9	10 or more

D. Please circle the number of trips you made during the past 7 days by WALKING. Remember, going to a place counts as one trip and returning from it counts as a separate trip.

	Number of Trips										
To and From Work?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Shopping?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From School?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Doctor, Hospital or Clinic?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From any other place?	0	1	2	3	4	5	6	7	8	9	10 or more

E. In some places, groups such as the Red Cross, Easter Seal Society, the local public bus company, churches, and other agencies provide transportation services for people with physical disabilities. Please circle the number of trips you made using a SPECIAL TRANSPORTATION SERVICE like this during the past 7 days. Remember, going to a place counts as one trip and returning from it counts as a separate trip.

	Number of Trips										
To and From Work?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Shopping?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From School?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From Doctor, Hospital or Clinic?	0	1	2	3	4	5	6	7	8	9	10 or more
To and From any other place?	0	1	2	3	4	5	6	7	8	9	10 or more

6. The Local Bus

A. How many blocks from your home is the nearest local bus stop?

_____ One block or less
_____ Two blocks
_____ Three blocks
_____ Four blocks or more
_____ Do not know

B. Are there any things between your home and the nearest bus stop, which prevent you from getting there in good weather? For example, are there curbs you can't get over, surfaces that are too rough, or intersections that are too hard to cross? Please place an X beside all those things that apply to you.

_____ No sidewalk
_____ Curbs
_____ Rough surfaces
_____ Intersections
_____ Hills
_____ Other, please specify

_____

_____ No problems

7. Planning a Trip

Suppose you are planning to go to a place that you had never been to before in this city. How much of a concern would each of the following things be to you in planning the trip? Please circle a number between 1 (no concern at all) and 5 (of greatest concern) for EACH.

	No Concern at all	A Little Concern	Somewhat More Concern	Very Concerned	Of Greatest Concern
The weather	1	2	3	4	5
Getting transportation to the place	1	2	3	4	5
Getting someone to go with you	1	2	3	4	5
Hilly sidewalks	1	2	3	4	5
Getting in and out of the place where you would be going	1	2	3	4	5
Getting around inside the place where you would be going	1	2	3	4	5
Crossing an intersection	1	2	3	4	5
Getting over curbs	1	2	3	4	5
Getting over or around bumps in a sidewalk	1	2	3	4	5
Getting around a place that has no sidewalk	1	2	3	4	5
Getting lost	1	2	3	4	5
Getting transportation back home	1	2	3	4	5
Heavy auto traffic	1	2	3	4	5
Getting robbed or mugged	1	2	3	4	5
Being embarrassed because of your disability	1	2	3	4	5
Cost of trip	1	2	3	4	5
Crowded sidewalks	1	2	3	4	5

Other (please specify) _____

_____

_____

8. Deciding How to Go Somewhere

How important are each of these to you? Please circle a number from 1 (not important at all) to 5 (of greatest importance).

	Not Important At all	Somewhat Important	Important	Very Important	Of Greatest Importance
To be able to go wherever you want to?	1	2	3	4	5
To get there in as short a time as possible?	1	2	3	4	5
To have lots of room while you are riding?	1	2	3	4	5
To ride for free?	1	2	3	4	5

	Not Important At all	Somewhat Important	Important	Very Important	Of Greatest Importance
To be able to afford the ride?	1	2	3	4	5
To not have to wait very long for a ride?	1	2	3	4	5
To have someone to help you who knows how to help a person with your disability?	1	2	3	4	5
To be able to get there without having to change vehicles?	1	2	3	4	5
To be safe from crime?	1	2	3	4	5
To ride by yourself?	1	2	3	4	5
To be able to go when you want to go?	1	2	3	4	5
To be able to get in and out of the vehicle with little or no trouble	1	2	3	4	5
To get a ride without having to make a reservation?	1	2	3	4	5
To not have to go very far to get to the vehicle?	1	2	3	4	5
To ride without sudden starts, stops and turns?	1	2	3	4	5
To be able to go to more than one place on the same trip?	1	2	3	4	5

9. Community Services and Opportunities

Would you personally benefit more from:

_____ More educational opportunities
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ Better health care
or
_____ More employment opportunities

Would you personally benefit more from:

_____ Better public transportation
or
_____ More opportunities for recreation

Would you personally benefit more from:

_____ Better streets and roads
or
_____ Better police protection

Would you personally benefit more from:

_____ More opportunities for recreation
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ More employment opportunities
or
_____ Better police protection

Would you personally benefit more from:

_____ Better health care
or
_____ More educational opportunities

Would you personally benefit more from:

_____ Better public transportation
or
_____ More employment opportunities

Would you personally benefit more from:

_____ Better streets and roads
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ More educational opportunities
or
_____ Better police protection

Would you personally benefit more from:

_____ Better health care
or
_____ Better public transportation

Would you personally benefit more from:

_____ Better streets and roads
or
_____ More opportunities for recreation

Would you personally benefit more from:

_____ Better health care
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ More educational opportunities
or
_____ Better streets and roads

Would you personally benefit more from:

_____ Better streets and roads
or
_____ More employment opportunities

Would you personally benefit more from:

_____ Better police protection
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ Better public transportation
or
_____ Better streets and roads

Would you personally benefit more from:

_____ More educational opportunities
or
_____ More employment opportunities

Would you personally benefit more from:

_____ Better public transportation
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ More opportunities for recreation
or
_____ More employment opportunities

Would you personally benefit more from:

_____ More educational opportunities
or
_____ Better public transportation

Would you personally benefit more from:

_____ Better health care
or
_____ Better streets and roads

Would you personally benefit more from:

_____ More employment opportunities
or
_____ Wider choices in housing

Would you personally benefit more from:

_____ More opportunities for recreation
or
_____ Better police protection

Would you personally benefit more from:

_____ Better health care
or
_____ Better police protection

Would you personally benefit more from:

_____ More educational opportunities
or
_____ More opportunities for recreation

Would you personally benefit more from:

_____ Better public transportation
or
_____ Better police protection

Would you personally benefit more from:

_____ Better health care
or
_____ More opportunities for recreation

---

10. Transportation Services

How much do you agree or disagree with the following. Please circle a number from 1 (very strongly disagree) to 5 (very strongly agree).

A. The local public bus should be made accessible to people with physical disabilities.

Very Strongly Disagree	Generally Disagree	Neither Agree Nor Disagree	Generally Agree	Very Strongly Agree
1	2	3	4	5

B. A special door-to-door transportation service should be provided for people with physical disabilities.

Very Strongly Disagree	Generally Disagree	Neither Agree Nor Disagree	Generally Agree	Very Strongly Agree
1	2	3	4	5

C. People with physical disabilities should be allowed to use the local taxi service at a lower fare.

Very Strongly Disagree	Generally Disagree	Neither Agree Nor Disagree	Generally Agree	Very Strongly Agree
1	2	3	4	5

D. People with physical disabilities should be given financial assistance by the government to help them pay for any transportation service they can use.

Very Strongly Disagree	Generally Disagree	Neither Agree Nor Disagree	Generally Agree	Very Strongly Agree
1	2	3	4	5

11. Some Things About You

To help us understand better the results of this survey, we need to ask you a few questions about yourself and your household. Please remember that your answers will be kept strictly confidential.

A. Where do you live? (check one)

_____ Your own house or apartment?

_____ A house or apartment of a friend or relative?

_____ A group home?

_____ Other, please specify _____

B. How long have you lived in this city or town?

_____ Years

C. What is the year of your birth?

_____

D. Your sex is: (check one)

_____ Male

_____ Female

E. Counting yourself, how many people are there in your household?

_____ Number of people

F. How many cars and other motor vehicles such as vans and pick-up trucks does your household have?

_____ Number of cars and other motor vehicles

G. Do you have a valid drivers license? (check one)

_____ Yes
_____ No

H. How many other people living in your household have a valid drivers license?

_____ Number of people with valid drivers license

I. Are you employed? (check one)

_____ Yes, Full Time

_____ Yes, Part Time

_____ No

J. How much education have you completed? (check one)

_____ 8th grade or less

_____ Less than 4 years of high school

_____ High school but no additional training

_____ Additional education such as college or vocational training

_____ College graduate

Are there any comments you have on the topic of availability and cost of transportation for the handicapped? _____

_____

_____

_____

_____

- -

OPTIONAL

Would you like a copy of the results of the study?

_____ No _____ Yes

Name & Address

_____

_____

_____

_____

Table B-1. Social, Economic, and Demographic Characteristics of the Respondents to the Mail Survey.

Characteristic	Number	Percent
Age		
11-20	4	2.4
21-30	42	25.0
31-40	47	28.0
41-50	39	23.2
51-64	25	14.9
65 and over	9	5.4
No response	2	1.2
Sex		
Female	85	50.6
Male	81	48.2
No response	2	1.2
Driver's License		
Licensed to drive	69	41.1
Employment Status		
Unemployed	85	50.6
Employed part-time	21	12.5
Employed full-time	59	35.1
No response	3	1.8
Level of Education		
8th grade or less	14	8.3
Less than 4 years of high school	13	7.7
High school but no additional training	25	14.9
Additional education such as college or vocational training	65	38.7
College graduate	47	28.0
No response	4	2.4
Type of Dwelling Unit		
Own house or apartment	115	68.5
House or apartment of friend or relative	28	16.7
Group home	7	4.2
Other	17	10.1
No response	1	0.6
Length of Residence in City or Town		
0-5 years	45	26.8
6-10 years	20	11.9
11-15 years	24	14.3
16-20 years	14	8.3
21-30 years	29	17.3
31-40 years	15	8.9
41-50 years	10	6.0
Over 50 years	10	6.0
No response	1	0.6
Household Size		
One	48	28.6
Two	40	23.8
Three	30	17.9
Four	28	16.7
Five or more	15	8.9
No response	7	4.2
Household Motor Vehicles		
None	50	29.8
One	58	34.5
Two	36	21.4
Three or more	21	12.5
No response	3	1.8
Licensed Drivers in Household		
None	69	41.1
One	40	23.8
Two	38	22.6
Three or more	19	11.3
No response	2	1.2

Number of respondents = 168

Table B-2. Functional Problems of Respondents to Mail Survey.

Functional Activity	Can Do with No Difficulty (%)	Can Do with a Little Difficulty (%)	Can Do with Difficulty (%)	Can Do with Much Difficulty (%)	Cannot Do at all (%)	No Response (%)
Walking	11.9	30.4	16.1	12.5	29.2	0.0
Going up and down steps	7.7	25.6	13.7	17.9	33.3	1.8
Standing for more than a few minutes	20.8	24.4	14.3	12.5	25.0	3.0
Using one or both arms	50.0	29.8	9.5	7.1	3.0	0.6
Seeing even with glasses	67.3	16.1	7.7	3.6	4.2	1.2
Hearing even with a hearing aid	85.7	6.5	2.4	1.2	0.6	3.6
Speaking	83.3	8.9	3.6	2.4	0.6	1.2
Sitting in a regular chair	63.7	19.0	8.9	5.4	3.0	0.0
Getting up from a regular chair	35.1	20.8	12.5	9.5	19.0	3.0
Bending over to pick up something	27.4	25.0	12.5	14.3	20.2	0.6
Lifting something that weighs 10 pounds	28.0	22.0	17.3	11.9	20.2	0.6
Holding onto something with your hands	54.8	22.0	9.5	7.7	5.4	0.6
Reaching for something above your head	38.7	27.4	10.1	13.1	9.5	1.2

Number of respondents = 168

Table B-3. Special Aids Used by Respondents to Mail Survey.

Special Aid	Number	Percent
Wheelchair	84	50.0
Seeing eye dog or guide dog	1	0.6
Personal escort	28	16.7
Artificial leg or foot	2	1.2
Artificial arm	1	0.6
Leg brace	16	9.5
Neck brace	3	1.8
Arm brace	4	2.4
Back brace	5	3.0
Walker	25	14.9
Cane for support	26	15.5
Cane for blindness	14	8.3
Crutches	16	9.5
Teletype or TTY machine	4	2.4
Other type of aid	0	0.0
Uses no special aid	22	13.1

Number of respondents = 168

Table B-4. Physical Ability of Respondents to Mail Survey to Travel by Alternative Modes of Transportation.

Modes of Transportation	Can do with No Difficulty (%)	Can Do with a Little Difficulty (%)	Can Do with Difficulty (%)	Can Do with Much Difficulty (%)	Cannot Do at All (%)	No Response (%)
Drive a car not specially equipped for a disabled driver	17.9	2.4	3.6	4.2	67.9	4.2
Drive a car specially equipped for a disabled driver	28.0	10.1	3.0	3.0	39.3	16.7
Ride in a bus	32.1	23.2	9.5	8.9	20.8	5.4
Ride in a car	63.7	19.6	7.7	4.2	1.8	3.0
Ride in a taxi	57.1	19.6	7.1	6.5	4.8	4.8
Ride in an airplane	51.2	16.7	12.5	8.3	3.6	7.7
Ride in a train	45.8	12.5	11.3	11.9	7.1	11.3

Table B-5. Distance from Respondents' Homes to Nearest Local Bus Stop.

Distance from Home to Nearest Bus Stop	Number	Percent
One block or less	70	41.7
Two blocks	30	17.9
Three blocks	18	10.7
Four blocks or more	35	20.8
Do not know	9	5.4
No response	6	3.6

Number of respondents = 168

Table B-6. Obstacles Between the Home and the Bus Stop Faced by Respondents to the Mail Survey.

	Number Citing as Obstacle	Percent
No sidewalk	36	21.4
Curbs	41	24.4
Rough surfaces	36	21.4
Intersections	39	23.2
Hills	22	13.1

Number of respondents = 168

Table B-7. Frequency at Which Respondents Travel Unaccompanied by Another Person.

Frequency	Number	Percent
Never	28	16.7
Less than once a month	16	9.5
One to three times a month	7	4.2
Once or twice a week	19	11.3
Three or four days a week	17	10.1
At least five days a week	79	47.0
No response	2	1.2

Number of respondents = 168

Table B-8. Frequency Distribution of Total Trips per Person per Week by Respondents to the Mail Survey.

Total Trips per Person per Week	Number of Respondents	Percent of Respondents	Cumulative Percent of Respondents
0	3	1.8	1.8
1-2	4	2.4	4.2
3-4	6	3.6	7.7
5-6	11	6.5	14.3
7-8	11	6.5	20.8
9-10	12	7.1	28.0
11-12	19	11.3	39.3
13-14	8	4.8	44.0
15-16	9	5.4	49.4
17-18	9	5.4	54.8
19-20	15	8.9	63.7
21-24	26	15.5	79.2
25-28	12	7.1	86.3
29-32	9	5.4	91.7
33-36	4	2.4	94.0
37-40	2	1.2	95.2
Over 40	8	4.8	100.0

Table B-9. Frequency of Travel by Respondents to the Mail Survey by Mode of Transportation.

Trips per Person per Week	Cumulative Percent of Respondents				
	Private Auto	Local Bus	Taxi	Walk	Special Transportation
0	15.5	68.5	83.9	67.3	68.5
1-2	25.6	75.0	91.1	77.4	75.6
3-4	32.7	78.6	94.0	83.9	81.0
5-6	41.7	82.1	94.6	89.3	87.5
7-8	48.8	85.7	95.8	91.1	89.9
9-10	57.7	91.1	97.6	94.6	96.4
11-12	67.9	94.0	98.2	96.4	98.8
13-14	73.2	96.4	99.4	98.8	99.4
15-16	76.2	98.2	99.4	98.8	100.0
17-18	81.0	98.8	99.4	100.0	--
19-20	86.3	99.4	99.4	--	--
21-22	89.3	100.0	99.4	--	--
23-24	93.5	--	99.4	--	--
25-26	96.4	--	99.4	--	--
27-30	97.6	--	99.4	--	--
31-50	100.0	--	100.0	--	--

Number of respondents = 168

Table B-10. Frequency of Travel by Respondent to the Mail Survey by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	41.7	26.8	85.1	56.5	20.8
1-2	45.2	55.4	88.7	77.4	41.7
3-4	50.6	72.6	91.1	87.5	53.6
5-6	53.6	86.3	91.1	92.3	63.7
7-8	58.3	91.7	91.7	92.3	69.6
9-10	89.9	98.2	96.4	94.6	86.9
11-12	90.5	98.8	97.6	96.4	93.5
13-14	91.7	99.4	97.6	96.4	95.8
15-16	94.0	100.0	98.2	97.0	97.6
17-18	95.2	--	98.8	98.2	97.6
19-20	98.8	--	100.0	98.8	98.8
21-30	100.0	--	--	100.0	100.0

Number of respondents = 168

Table B-11. Respondents' Frequency of Travel by Private Auto by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	61.9	39.3	90.5	72.0	32.7
1-2	66.1	65.5	91.7	87.5	54.8
3-4	69.6	83.9	94.0	94.6	67.3
5-6	73.8	94.0	94.6	98.2	76.8
7-8	76.8	96.4	95.8	98.2	83.3
9-10	100.0	100.0	100.0	100.0	100.0

Number of respondents = 168

Table B-12. Respondents' Frequency of Travel by Local Bus by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	82.7	91.7	97.0	90.5	83.9
1-2	84.5	98.2	97.6	95.2	93.5
3-4	85.1	99.4	98.2	98.2	96.4
5-6	88.1	99.4	98.8	99.4	98.2
7-8	90.5	100.0	99.4	99.4	99.4
9-10	100.0	--	100.0	100.0	100.0

Number of respondents = 168

Table B-13. Respondents' Frequency of Travel by Taxi by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	94.6	96.4	99.4	92.9	92.3
1-2	95.2	99.4	99.4	95.2	97.6
3-4	97.0	99.4	99.4	98.2	98.8
5-6	97.6	99.4	99.4	99.4	99.4
7-8	98.2	99.4	99.4	99.4	99.4
9-10	100.0	100.0	100.0	100.0	100.0

Number of respondents = 168

Table B-14. Respondent's Frequency of Travel by Walking by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	94.6	82.1	99.4	95.2	77.4
1-2	96.4	94.0	99.4	96.4	86.3
3-4	97.0	96.4	99.4	98.2	93.5
5-6	98.2	98.8	99.4	100.0	97.0
7-8	98.2	99.4	99.4	--	98.2
9-10	100.0	100.0	100.0	--	100.0

Number of respondents = 168

Table B-15. Respondents' Frequency of Travel by Special Transportation Service by Trip Purpose.

Trips per Person per Week	Cumulative Percent of Respondents				
	Work	Shopping	School	Medical	Other
0	88.1	96.4	94.6	86.3	91.1
1-2	89.3	100.0	97.4	92.3	96.4
3-4	91.1	--	97.0	95.8	99.4
5-6	92.3	--	97.6	98.8	100.0
7-8	94.6	--	98.2	99.4	--
9-10	100.0	--	100.0	100.0	--

Number of respondents = 168

Table B-16. Average Trips per Person per Week by Mode of Transportation and Trip Purpose.

Mode of Transportation	Average Trips per Person per Week					
	All Trips	Work Trips	Shopping Trips	School Trips	Medical Trips	Other Trips
Privately owned car	10.5	3.0	2.3	0.6	0.9	3.6
Local public bus	2.5	1.3	0.2	0.2	0.3	0.5
Taxi	1.0	0.3	0.1	0.1	0.3	0.2
Walking	2.0	0.3	0.6	0.1	0.2	0.9
Special transportation	2.0	0.9	0.1	0.3	0.5	0.2
All modes	18.0	5.8	3.3	1.2	2.2	5.5

Table B-17. Percent Distribution of Respondents' Trip by Mode of Transportation.

Mode of Transportation	Percent of Trips by Mode					
	All Trips	Work Trips	Shopping Trips	School Trips	Medical Trips	Other Trips
Privately owned car	58.1	51.3	70.8	52.4	41.0	66.0
Local public bus	14.1	23.1	6.6	13.5	14.4	9.1
Taxi	5.6	5.7	3.6	4.8	12.5	3.9
Walking	11.1	5.0	17.0	4.8	8.2	16.6
Special transportation	11.1	14.9	2.0	24.5	23.9	4.3
	100.0	100.0	100.0	100.0	100.0	100.0

Table B-18. Percent Distribution of Respondents' Trips by Trip Purpose.

Trip Purpose	All Trips	Private Auto Trips	Local Bus Trips	Taxi Trips	Walk Trips	Special Transportation Trips
Work	32.4	28.5	52.9	33.3	14.6	43.4
Shopping	18.1	22.1	8.4	11.9	27.8	3.3
School	6.9	6.2	6.6	6.0	3.0	15.2
Medical	12.2	8.6	12.4	27.4	8.9	26.2
Other	30.4	34.6	19.7	21.4	45.7	11.9
	100.0	100.0	100.0	100.0	100.0	100.0

APPENDIX C

TRANSCRIPTS OF IN-DEPTH PERSONAL INTERVIEWS WITH FIVE HANDICAPPED PERSONS IN KNOXVILLE, TENNESSEE

The following are transcripts of in-depth personal interviews with four handicapped persons in Knoxville, Tennessee. The interviews were conducted by Dr. Thomas C. Hood, Acting Chairman of the Department of Sociology, The University of Tennessee, Knoxville. The interviews illustrate, rather directly, the problems that handicapped people face in traveling and the effect their limited mobility has on their lifestyle.

INTERVIEW A

I*: To start out with, about when you were born?

R*: I was born August 28, 1912.

I: 1912, isn't that great? That's great. How far did you get in school?

R: Through the 7th grade.

I: And where do you live now here in Knoxville?

R: I live out in Burlington.

I: Do you live near a bus line?

R: No, it's a little bit far for me to walk.

I: To the bus?

R: To the bus because I'm crippled--stiff knees, and you know I have problems walking. And I walk with a cane, too, and so I don't never, you know, go anywhere unless I just come over here, go shopping and no more, 'cause I'm not able to.

I: How long have you had that problem?

R: Oh, it's been working on me seven years, but man, it's worse the older I get, of course. I had a birthday the other day, I'm 70. You know I just don't go nowhere. I just stay around home there, able only to come over here for an hour and watch TV.

I: You just come over about once a week?

R: Once a week.

I: What kind of place do you live in? Do you live in an apartment or . . .?

R: No, I live in a house.

I: Just a regular house?

R: Uh-huh.

I: Anybody live with you?

R: Yes, I have a little retarded son. He's with me. And of course I have to have somebody with me to take care of me because my husband died six years ago, and one of my other boys he's on the disability list, and he lives with me.

---

*I: Interviewer
R: Respondent

I: So you have two sons that live with you. Right? One of whom is retarded and the other one is disabled?

R: Yes, and he don't get no kind of assistance. Just a little food stamps. That's all he gets.

I: Okay, and you say you've had your own difficulties, stiffness in the knees and having to use a cane for what, 10 years?

R: No, I haven't used it for ten years. I've been walking with a cane I guess about three years. See, I was working on a program, a Senior Aide program, until the beginning of this. I went to get on the city bus and I pulled a lever in my leg. They don't call them levers. I guess they have a name for them. I pulled it in my leg and it felt like my leg was broke in two, and I haven't been able much to ride the city bus since. And these buses, CAC buses pick me up and they have a stool I can step on if I need to get up on the bus.

I: You can make that step?

R: Yes.

I: But the city bus is a little high?

R: Yes. I have trouble getting off. You know, I'm slower than anybody else and they some of them short of patience with me. I just stay at home, you know, mostly.

I: So you're retired then I guess?

R: Yes.

I: What did you do when you were working?

R: Well, I was a, when I was working, I was a working in a home--domestic work.

I: Domestic work?

R: Uh-huh, when I really was working, but after I got older, I got me this problem you know.

I: The senior aide program?

R: Yeah, and I worked with the handicapped.

I: Were you, did you help in that program quite awhile?

R: About six or seven years.

I: Oh, well, that's good.

R: Uh-huh, until I hurt my leg. I couldn't get around.

I: How would you say your income influences your lifestyle with regard to transportation? In other words, do you have the kind of money you need to travel the way you would like to travel, I mean, to get around the city the way you'd like to get around?

R: No, I don't have no transportation and I don't have money to, you know, take a cab or something, I don't have the money.

I: Did you ever drive?

R: No.

I: So, basically then, you used to travel on the bus quite a bit but now you travel just by the van or do you still?

R: Yeah, that's about the only way. Sometimes a friend will come and pick me up. You know, some of my neighbors. They see me trying to go to the store and they take me to the store and bring me back. Come back and get me you know. I'm not able to shop for groceries and things like I would like to be. 'Cause I can't get out.

I: About how many trips would you say you make a week? You said you can come over here one day a week and that would be one trip over and another trip back. So, if we talk about one-way trips, all right, one over here and one back would be two. About how many trips would you say you make in a week?

R: I guess about four if we're counting both ways. That's what you're talking about. 'Cause I gotta go to the, try to go to the store once a week if I can.

I: Do you get to church at all?

R: Yes, I go to church.

I: Okay, so that would be two more.

R: There's a lady that picks me up and carries me to church. One of the members.

I: Okay, so over here and back once, thats two, and then to the store and back, that's four, and to church and back, that's six. Is that about what you do in most weeks?

R: Yeah.

I: And mostly, then, when you come over here, it is on the van, when you go to the grocery store, it's mostly with somebody picking you up and bringing you back, and when you go to church it's somebody picking you up and bringing you back--usually a friend or a neighbor.

R: Yes.

I: When you go grocery shopping, what are the kinds of things that you think about when you decide to go grocery shopping in terms of, like, where do you go?

R: You mean . . .?

I: Well, the store you choose.

R: The store I choose?

I: Yeah, right. Do you always go to the same store?

R: No, not always. I guess I would if I had transportation, but the way people's going, I mean if they're going to the store they pick me up and carry me. I go to the store that is most convenient for them. I don't have no special store. I use to trade at the A&P store a lot, but since one is not near me, I just go to IGA and some of them are Kroger's. And, I want to call them Grant's, but its Giant. When I go there, I'm close to K-Mart. Maybe I need some hose or something. I can go into K-Mart and get them or whatever, and then go into the grocery store and get my groceries. I try to keep.

I: Try and keep them together?

R: Yeah.

I: So you don't have to make too many trips?

R: That's right.

I: Now, when you go to the doctor, how do you get to the doctor?

R: Well, they carried me for a while on the CAC bus. I was signed up for that transportation, but since then I just, you know, maybe some of the neighbors around there. There's a little girl near around the corner. I asked her would she run me to the doctor and pick me up, and she said yeah. Of course, I have to give her a little donation, unless she's going that way.

I: So, now when you picked out your doctor, did you pick out a place that was easy for you to get into or out of or did you just pick the doctor because you liked that doctor or what?

R: No, I was sent to this doctor that I go to. Then he sent me back to my family doctor. He's nearby. It is still out in East Knoxville.

I: But its near Burlington?

R: It's not too far from Burlington.

I: Is that mainly the medical trips you take, or do you have to go to the hospital every now and then?

R: Well, no, not since I was in the hospital about three or four years ago. Yeah, I did. My blood pressure went up, and they carried me into emergency. But I don't have to go to, I should go to, but go to a doctor. I try to get a place where I have to pay the full amount for my medicine, and I try to get a place where I can get a discount from that and, but so far I haven't. Could you tell me anything about that?

I: Where you can get a discount on your medicine?

R: Um-huh. You know, just like my doctor writes a prescription. He don't tell me what, I'm talking about a discount, he don't tell me where to go to or nothing but he just writes it out. If its $30 or $40, I have to pay it. One week I went, my medicine one month was, I had all of them filled at one time, and it was, one prescription, he had about three on there, it was $33, the next one was $8, and his bill was, you know how emergency is, I mean $12 or $15 dollars, and there my money was just about gone. Any time I bought some food and pay my house rent. Now every once in a while, once a year, I get a check back, and I guess that's the discount, isn't it? That's the check.

I: A little bit. What do you do for recreation?

R: Nothing but . . . what do I do? I come over here.

I: You come over here and go to what? What do you do over here?

R: Make ceramics. And I have went to a bible class. I have went to sewing class. But now I didn't take up all night, just visit around, walk around, visit, but mostly I'm making ceramics.

I: Do you do anything else? Do you do anything with your church for recreation? Have, you know, get-togethers, covered dishes?

R: Yeah, we have food meals, and we bring things.

I: Ever have hymn sings?

R: Oh yeah, we have sings, and on Wednesday, we have the middle of the day prayer meeting, and most of the senior citizens go, and I have went, I have come over here and worked and let them pick me up and carry me. On my lunch hour. And then they bring me back over here.

I: Somebody from the church comes over?

R: Yeah, and I'm here when the van comes to pick me up. I try to be ready in the morning when they come by. Once I did go twice a week but you know I just cut down to one day a week.

I: Well, I guess you couldn't hardly get over here if you didn't have the van come and pick you up?

R: No, I wouldn't, I couldn't.

I: I've got one last question I'd like to ask you. When you're asked to go to somebody's house, or when you go to, say, a different doctor or something like that; when you go someplace in Knoxville that you've never been before, and so you're not familiar with the area, what are some of the kinds of things that you think about in terms of deciding whether or not you'll make the trip?

R: I don't hardly get it.

I: Okay. Well, what we're trying to get at is, let's say that you're invited to go to somebody's home, or let's say that you're supposed to go to a doctor and you've never been in that particular part of the town, or you decide to go shopping someplace that you've never been before, are there some things, problems, that you think about before you, as you plan to go, as you make your plans to go. Like, somebody might say, well, if you're going to go someplace, you got to have transportation, but beyond just thinking about transportation, is there anything else you think about like whether or not it is raining, whether or not you think that section of town's okay to get around in, or you know, things like that. Whether or not you think it's too hilly in that place where you go. Things like that. Do you ever think about anything like that?

R: Yes, I sure do, and I think about if I get there. Now I was invited somewhere Sunday, and it was a club meeting, you know, the community club. The girl, she lived on Victoria Street, and its straight up a hill. I said, okay, if I can get up that hill. I have problems getting down it. You know 'cause I'm scared, seem like I'm going over my head you see. I said, "Honey, I can't come 'cause I can't come. I might can get a ride," I said, "but I can't get back down the hill." And she said, "Oh, I forgot about that." Cause I had trouble, they had to come and get me and help me up there. You know the last time I was up there. And I said I won't try that.

I: That's the kind of thing we mean. Anything else like that that you think about before you go someplace?

R: Well, first thing I think about, well how is I going to get there and who's going to carry and who's going to come and get me. You know, I think about that. If I be lucky enough to get me a ride or somebody come by, some of the members call me. How is I going to get back? Maybe they say, "I come and get you." Well, I'm beginning to wonder then, if they come after me, will they bring me back, and if I have time, I will ask them, "Is you going to bring me back?"

I: You ever have any problem with bumps in the sidewalk or, you know, with places that are bad in the sidewalk?

R: When I'm walking alone? Yeah. Yeah, 'cause I fell. When I was really working, I fell going up Highland Drive, and I thought I broke my cheekbone. You see, is one of them a little darker than the other one? But I thought, they thought it was cracked, but it wasn't. They carried me to _____ and had it X-rayed.

I: And that's because it's a bad place in the sidewalk?

R: Yeah, bad, you know, on the curb. I was walking on the side, well, how they raise it up, you know like that. Somehow or another I just fell, and I fell the right way 'cause if I fell this way, the traffic would have got me, and that was, I would call myself young then, you know, so I always have a vision of falling, you know, think I'm gonna fall. Of course, now I know I will--that's the reason I kept my cane along.

I: Do you have to take any medication with you when you travel?

R: Yes, I've got my pocketbook full now. Yeah, I take my medication.

I: And your cane of course.

R: Yeah, but if I take most of my medication before I leave, which it would push me, I can't, that's too many at one time you know, and I carry the rest of them with me and take it during the day.

I: How about the weather? Do you ever think about that before you make a trip? Does the weather ever keep you in?

R: Yeah, if it's storming or something, you know, I won't go out even then if it looks like it's

going to rain, 'cause I can't run no more. I get out of the rain, and I just won't go.

I: Do you travel at all when it snows or anything like that?

R: No more. I hardly go outside all days. One of them will come over here, and they clean the sidewalk off and everything.

I: Do they come right to your door when they pick you up over here?

R: Yeah, very nice.

I: Have you ever ridden on the Lift?

R: No. So far I don't need it you know. The only thing I need, the little push up to get on, and I have trouble getting off. See, where I get ready to get off, my knees won't revolve, and sometime when I go to step off, I holler you know. Scared the bus drivers. I tell them I can't let go, I'm holding to something. I can't let go cause I'm afraid I'll hit the ground. You're kind of reaching out there with that foot and you want that foot to be on the ground before. I tell them, I said, "Well, ya'll be patient, I'll get off in a minute." And I try this and then I try that, you know. Finally I make it. They all are gentlemen, nice.

I: Have you ever had the experience of somebody telling you that they're going to come and get you and give you a ride someplace and then they didn't show up?

R: Yeah, I sure have, a lot of times. Yeah, sometimes, something happens, you know, that they can't come, and then I have had it the other way. Maybe they just think it's not important you know. But I don't like to be ready and thinking I'm going somewhere and don't get there. I try to be ready when I'm supposed to do something, you know, and I look for them, I get disappointed. I have to go and undress maybe and think about what I'm going to do at that time.

INTERVIEW B

I: Why don't you tell me, first of all, to just sort of introduce yourself, about when you were born.

R: I was born in 1915 in Knox County.

I: You went you say through the sixth grade?

R: Sixth grade.

I: Where do you live now? Do you live in town or out in the country?

R: Knox County.

I: What part of the county?

R: Concord. Down toward Farragut.

I: Do you live in a house of your own, an apartment, or what?

R: I own my ground and I own my place. I live in a trailer.

I: You live in a trailer?

R: Yes, my house got so bad, I had to let it go. I tried to have the lights fixed, and it was leaking in it, and I got scared. Nobody couldn't fix it, so I had to do something else.

I: Right. Well now, do you live in a trailer park?

R: No, I own the ground.

I: Oh, you own the ground.

R: Yes, I finally got it paid.

I: So, you are off by yourself in a trailer. Does anybody live with you?

R: No.

I: Are you a widow?

R: Yes.

I: Now, how would you describe the nature of your handicap?

R: Well, I am not able to walk very far at a time?

I: About how far can you walk before you have to stop?

R: About four or five blocks. If I am carrying something, I have to stop before then.

I: Do you have anything else that is hard for you to do?

R: To get to the doctor's.

I: Hard to get to the doctor's, right. Do you have a little arthritis problem?

R: I'm nearly crippled. See it started in these shoulders, and now its come down this way in my elbow, and I can't hardly stand it. It hurt so bad yesterday, and me taking pills for it.

I: How long have you had arthritis?

R: Ah, four years.

I: And how long has it been that you have had difficulty walking any distance?

R: Well, it's been a good little bit. See, I had tumors took off my heels and some on my toes and on the side of my feet, so it has been bad.

I: Now you are retired? Did you work?

R: No. I kept my kids at home and stayed with them. Back then they didn't work.

I: Now, when you think about the money that you've got coming in, how does that influence the way you live in terms of what transportation is available to you? Do you have enough money to get the transportation that you want or could you use more money to get different kinds of transportation?

R: Well, no, there is no buses running anywhere I have to go. And if I don't get this I'm just stuck and I couldn't take it.

I: You don't drive?

R: No.

I: Did you ever drive?

R: No, I wish I had. I wouldn't bother so many other people. But with this arthritis, it surprises me being in my arms, 'cause it's usually in my knees and ankles, and I had varicose veins taken out, too, but not the way they do them now. The doctors put little needles in the veins and let them stay about 45 minutes and they don't come back. Well, he told me when he had to go to another business, he took care of football players, certain kind of bone doctor, so I had to quit him and hunt another one. This one I go to just gives me something for arthritis. One week I couldn't get to it and I was out and I got really crippled. I got so I have to call up here to get somebody to take me to the drug store 'cause I can't afford to do without that medicine, and I still have artiritis bad enough with it.

I: About how many trips would you say you make a week when you think of these as one-way trips; like, coming over here would be one trip and going back would be another trip, so that would be two. About how many trips would you make in a week.

R: I come Monday and Wednesday and Thursday.

I: To here?

R: Yea.

I: OK, that's six.

R: That's all.

I: Do you not have any shopping trips or any trips to the doctor?

R: Well, I ask them to stop, as I go home, to the store.

I: So you got six trips a week.

R: And I do pay them one way to get to the store. After I come from over here going home, 'cause it's right on the road home. And I do ask them to take me to the doctor, maybe once or twice a month.

I: Now, do you travel just on the van?

R: Yea. But I've been on disability, and they told me I got a raise in July and they let me know before I got the raise that they was going take part of it back. And I wondered why. They act like they think I've got better than I have, but I don't. So, and they wrote me again and said the other day, "Remember, the first of September, we are going to cut your pay." Why? Well, another thing that bothers me. I went to a new doctor and was going to stay, but he didn't add it on that I had the cards to pay for this and I had a time getting this straightened out and I still have to pay part of it. Well, see, they take out of me on the first of the month for doctors and hospital and stuff like that, and the way they done that, I was paying and they was taking it out of my check too. I paid a ten dollar bill over at UT hospital last week that I hadn't paid before. But it was for what work the doctor done. Some test he run. But now I got the card, and it's supposed to pay for it. I paid two or three bills over there that I wasn't supposed to pay that I hadn't paid before.

I: Do you ever have friends or neighbors give you a ride someplace?

R: Well, I don't ask them, but I know they all work. They don't have much chance to.

I: Right. Do you get to church at all?

R: Yea. I go with some of my neighbors on Sunday and sometimes on Wednesday.

I: Do you walk there or what?

R: No. I couldn't make it walking.

I: Somebody comes and gets you?

R: Yea. The people across the road goes to the same church, so I go as they go.

I: I see, so you ride with them in their car.

R: I hate to call on them all the time so I try not to.

I: One of the things you said that you consider when you go grocery shopping is you try to do it on a trip back from the Center here, right?

R: Yes.

I: Do you always go to the same place?

R: Well, pretty much.

I: Is that store laid out so that you can get around in it good?

R: Yes, it is the A&P down in Farragut.

I: Okay. It's easy to get in and out of, is it?

R: Yes.

I: Is there any particular reason you picked that store to shop at?

R: Well, mostly because it's close.

I: Now, when you go to the doctor or make some other medical trip, what kind of factors do you have to consider about getting to the doctor? When you make the plans for the trip, what do you have to think about?

R: Like what?

I: Well, like, do you have to call ahead to get transportation lined up, things like that?

R: Yes, I do that.

I: After or before you make the appointment?

R: Well, after I get the appointment, 'cause I know what day then, and they like to know a day or two or three before you go so they will know which way to go.

I: And when you get to the doctor, is it easy to get in and out of the doctor's office?

R: Yea.

I: Okay. Some places are not so easy to get in and out of, and I just wondered if you had any problems.

R: Well, see, I tried to get to a drug store that's close to me, too. But, they got so, I don't know why, they take a prescription, you sit down and wait about an hour when they have nothing to do, and when I get home and I look at the medicine, they had give me somebody elses. I had that happen three or four times. I don't go there no more, and anyway, they're not busy, and I go in and turn it in, and he takes it and looks at it, and I don't know what he does but it takes an hour. And you know transportation don't like to do that. They got other places to go. So I started at Cedar Springs Shopping Center. Well, they take it and get it ready, and you've got it in less than 20 or 30 minutes.

I: So now you make a special trip over to Cedar Springs?

R: Yea, to get prescriptions I do.

I: What do you do for recreation?

R: Well, mostly ceramics. I had a nervous breakdown a few years ago, and I had to go to Helen Ross McNabb Center, and that doctor put me on nerve pills when I need it. Well, I been going two years, at least, and I told him one day, "Wasn't it time for me to get off?" He said no, but it was a good idea he didn't take me off because I got a younger daughter. She caused me a lot of trouble, and to get nerves settled, I have to take a capsule that he prescribed.

I: Does she live here in town?

R: Down there where I live.

I: Not too far from you?

R: But she don't speak to me anymore. She told me one day she said, "Mom, if you don't do what I say, I'm not messing with you no more." And I didn't do what she said. But we've made up. I been crawling back. I worry about her. So I apologized three or four times, then I quit. She can speak if she wants to and she don't. She knows where I am.

I: Do you just do the ceramics in here at the Center?

R: Well, sometime I take some home with me that I want to finish.

I: Do you ever do anything with the church for recreation? Covered dish supper or anything like that?

R: No. I've not been going lately. I've been kind of sick. You see, I've got lung trouble and sometimes I can't go.

I: I've just got one more question. When you plan to go someplace, say like a doctor's office where you've never been before or someplace else that you've never been before here in the Knoxville area, what are the kinds of things or problems that you consider before you would make a trip like that?

R: Well, I consider trying to find somebody to take me instead of bothering transportation. You see, sometimes I can't find nobody. And the only way I can push is not to get off that arthritis pill and not to do without it. See I've got Parkinson's Disease and that's a must. You don't say I'll take it tomorrow and let it go today.

I: Right, you've got to take that. Right.

R: And so, I don't see that I can do without that.

I: So, the main thing that you'd be considering would be finding some way to get there?

R: Right. I hate to call on them, especially 'cause the places that I have to go is in my district, and they come all the way from town. If I can find another way I do.

I: Do you ever not travel because of the weather?

R: I usually go when I want to.

I: You usually go where you want to? And sidewalks or hills are not too much of a problem for you?

R: Well, the hills are. I've got that bronchial trouble and lung trouble, and I get out of breath, and I have to sit down or stand still or quit walking so far.

I: Do you have to carry medication with you then?

R: I've not been but it would be better if I did.

I: Can you think of anything else that you'd like to tell me about transportation?

R: Well, I say one thing. I never rode with better people. And they are good drivers, and I like them all. I think I've rode with them all.

I: You feel like it's a fair price?

R: They don't come no better, and I've been with them a long time.

INTERVIEW C

I: . . . approximate age, or when you were born, or something like that?

R: I was born in 1903.

I: And how far did you get in school?

R: I didn't get too far in grammar school. Married very young. And my husband left me with two little ones to raise. He traveled. And I had to raise them and I knew that.

I: Did you finish the 8th grade?

R: Yes, and then I was left with this home to take care of and the children so I had enlisted in the Knoxville Business College in 1933. I was a child.

I: Did you finish?

R: And the children in high school just graduated come in there to the Knoxville Business College, and they thought I was one of them. And you know when I set up at night and studied and took care of my children when I got home, we had just bought a six-room home, a beautiful home. I took care of that home and took care of my children, sent them to school, and I went to school.

I: So you finished Business College then?

R: I graduated at the Business College and I had some friend that was a councilman, and he put me in the City Hall, a big suite after I graduated. April 6, 1935. I finished, but didn't go the entire time from 1933 to 1935. I was out six months because my son had pneumonia, bronchitis. And I had to stay off until he got well and able to go back to school.

I: Do you still live in that same house that you bought back then?

R: I couldn't keep the house and work and keep the children, so I had to let it go back.

I: Where do you live now?

R: I live now at the Summit Towers. It's in town near the City Hall where I spent 32 years.

I: Do you have your own apartment there?

R: I have my own apartment.

I: Do you live alone?

R: I'm alone. I don't have a soul. I have a son of course. He has his family.

I: He lives here in town?

R: Yes, and I have nobody else.

I: Does your brother live here in the community?

R: Out in Powell. I have nobody here. He's all I have left and my son, that's all.

I: How would you describe the nature of your handicap? Could you describe that?

R: Well, it's my back. It makes me so weak. When I get up to walk, I'm shaky.

I: And then your eyes?

R: I have to have support for my back and I've ordered this surgical garment and it's $75. I have to pay for that in cash. I'll get it, but it'll take quite a bit. What was the next question?

I: Would you call your eyes somewhat of a handicap too?

R: My eyes. Well, everything is blurred and I can't see, and when I walk I can't tell if . . . I'm really scared of stairs. I look down I can't see down. You can see from here to the door you can see on the floor, but straight down you can't. That's the worst feeling in the world. I crocheted all the time. I made two big afghans before this happened. Now I can't . . . you see I can't look down and see the needle. If the needle and my hands were over there two feet I could do it, but I can't crochet that way. And when I look at reading, I can't see that. I have to get right on . . . and then the lines run together after looking at it a minute. I'll start to read and I can't. I have to stop taking my paper. I can't even read it; it's getting worse.

I: Do you ever get the talking books that have . . .?

R: Yeah, they did that. They brought them out at first after the operation, but I couldn't go with it. I've been so used to doing things myself and going . . . I was just a go-go girl. I was on the go all the time. And just all of a sudden have to quit all that, cut all that out and depend on someone else, that's what tears my heart out.

I: Now you're currently retired, is that how you described . . .?

R: I retired in 1967. I spent 32 years down there at the City Hall, and I worked all around. I worked in every department of the City, and I took leave of absence, and they loaded me down with work, and I just couldn't get all of it done. They wouldn't give me any help, and I took three leaves. I worked in Baltimore, and I worked in Houston, Texas, two different years, and I worked in Los Angeles, east, west, north, and south. They weren't allowed to keep me only just extra because I wasn't cleared away here. I thought I was. I mean, I didn't want them to know I wasn't. But they can't take you and train you and then let you go. That's too expensive. Well, I had to leave those jobs but I worked in the best. I was the secretary to the president of the _____ Association, I was secretary in Houston at the _____ Company and relieved on the switchboard, and in Los Angeles I was secretary every place I went and made more money then I made here, 19 years of service here. I made more money there to begin with than I made here. And I was welcome back any time I wanted to come back and take the job. So that was great to me.

I: How would you say your present income influences the way you live with regard to transportation? Is your income . . . does that limit the amount that you can travel, or do you?

R: I wish I could travel. I can't see to travel. If I could, I don't have the money, the doctors and the pharmacists take my money. See, I've had two abdominal surgeries for malignancy, and I'm still paying on those. Three years ago.

I: So you really just don't have the money to do much more than the essentials?

R: Just live and that's all.

I: So most of the trips you take are just trips that . . .?

R: I can't afford to take a trip. All I go is to the grocery store and back. Now that covers my territory. And I get so fed up with that.

Just to the grocery store; no entertainment, no social life except through church. I go to the church and socialize with them. Now that's my life. The grocery stores and the church and home is my life.

I: And occasionally over here I guess.

R: And here, of course, you understand that.

I: Do you go to the grocery store every week?

R: My son takes me every day he is off. I mean he's off one day a week and he spends that time taking me to the market. I pay for the gas.

I: So you go to the market and back. That's two trips then. Then about how often do you come over here?

R: Twice a week. Some weeks, not at all. Other days, once and twice a week.

I: So that's on the average probably another two trips. Because you probably get over here once a week on the average?

R: I've been trying to come Tuesdays and Thursdays, but I've left Tuesdays off and just been coming Thursdays. I can't afford to come more often than that.

I: So that would be two more trips, that's four. Now do you go to church every week?

R: I go to church every Sunday, and I have to put money in the church. I feel I'm obligated to do that.

I: So that's another trip to church and a trip back, that's six.

R: I put $5 in the church about every two weeks.

I: So that's six trips in the average week. Do you go to the doctor very often?

R: When I have to. It depends on how my eyes are; how my condition is. I have sugar in the blood, and I have to have that tested. And every time I go it's $23 and $33.

I: But that wouldn't be once a week would it?

R: No, it's about every three months or every two months, depending on how it is. And then if I have problems in the stomach where I had surgery in the upper part of the colon . . . why I have to go to C_____, he specializes in that. And that's $66 one trip. It keeps me down. You see I don't have money to buy any clothes if I pay them all.

I: So that would be just an ocassional trip. I guess probably you make about six or seven trips a week, wouldn't you say? That's one-way trips. That's coming over here and going back, that's two, and going to church and coming back, that's two more, that's four, going to the grocery store and coming back, that's six. Can you think of anything else you do in the average week?

R: I get my hair done 'cause I'm not able to do it anymore.

I: Do you do that about once a week?

R: No, every two weeks. I use to do it myself but I can't do it anymore. I get cramps in my fingers. I have arthritis. And my fingers draw and I can't roll my hair. I did up until last week or so . . . but when I start, my fingers draw. They cramp. I can't do anything about it. I go to the school of beauty because it's cheaper.

I: How do you usually travel? Do you usually go by private car or by bus?

R: My son comes once a week and takes me to the market.

I: That's by private car and then you come out here in the van do you?

R: Um-huh. Two dollars.

I: When you go to the beauty shop or the doctor would that be by bus or by car?

R: It's down two blocks from where I live, three blocks. I get someone to go down there with me, and I can get a ride sometimes down there. It's on the corner of Gay Street. It's two blocks.

I: When you go grocery shopping, could you tell me a little bit about what some of the things are that you consider, some of the factors that you consider, when you make your grocery shopping trip.

R: The necessities are all I get, the necessary things. The doctor has me . . . I have to be pretty strict on what I eat.

I: But I'm thinking more about not what you buy as the store you choose to go to because of your handicap. Do you pick a store that doesn't have many steps or do you pick a store . . .?

R: I don't have any steps at all where I go. He draws up as close to the door as he can get and he helps me in. He helps do the grocery shopping. I can't see the labels. And he does that for me, my son. If it wasn't for him, I don't know what in the world I'd do.

I: So you tell him what you want, and he picks it off the shelf?

R: He takes the cans, whatever I have to have there. Leads me by the vegetable counter, and on our way down I'm use to having good eats. I can do without clothes, but I can't do without the necessities of eating the right kind of food, green vegetables, and cheese, and milk, and green stuff as much as I can. And then the other things that go with it. That's all. Of course I try to cut down as much as I can because even the least of that costs . . . you know you'd be surprised as for what I have a week is $25 and $30. And just for me, that sounds very exaggerating, but I get chicken or get fish or something, that's what I'm supposed to have. I never buy steak. I'm not fond of it. But I like to smell it cooking. That's as far as I can go. I like to go around someplace where they're cooking it and smell it, and I would love to go out and eat occasionally, but I

can't afford it. I get so tired of that little old kitchen. It's a hole in the wall, you might say. It's a very small place just for one person. Of course, I have a counter that overlooks the living room. And I get tired of eating alone, and I have Jack to eat with me, my son. He comes out and eats with me, and I can't invite people in to eat cause I can't afford to pay for the groceries. And I have to have spending money. Bring me out here, and that's usually $10 or $15 dollars, and that runs about $20 to $35 and $40 on my checking account every week. Now that's every week. Besides my bills that comes at the first of the month. That runs, my rent is about $200 a month, and I pay all these doctor bills, and my rent, and my phone bill, and the groceries, I don't have much left. And I'd never have got under Social Security if I hadn't have gone away from here to work cause they didn't have it at the City Hall when I worked down there. I would have been on welfare suffering if I hadn't have strained myself. I think my footprints are on the sidewalk in Los Angeles. I think they are. I've walked east, west, north, south, I've walked all over looking for jobs. I can get good jobs but couldn't keep them long because I wasn't cleared away here. You've got to be completely cleared away, and I thought I'd fool them till I got a job at a place as secretary to the manager for L.A. _____ furniture company. They wrote back here and found out that I wasn't cleared away and that I was gone. In order to get a job I had to lie. I'd tell them, "Yes sir, I came out to live." My daughter was there and I came out to live with her. I meant to at the time but I couldn't afford it being under Civil Service. They didn't take out Social Security on me, they didn't have it down there, but I did get under it when I worked other places. I put in 12 quarters. That's in order to get in under it. And then just about four or five years before I left, they said they took it out.

I: Well now, we've talked about the grocery shopping trip. How about when you go to the doctor or go to the hospital for a medical trip. What are some of the factors that you consider when you make that trip?

R: How I get there you mean? Well, if my son can't take me on his day off I do get the transportation.

I: Oh, the Lift?

R: The Lift. That's what's been taking me back and forth has been the Lift.

I: Are they pretty good?

R: They were until they left me standing for hours and I had to get a cab. So I started depending on these people here since they did do it. I'd rather pay them than to pay the Lift. That's cheaper than . . . a cab costs me too much. And I'm afraid of getting on and off a bus, I can't see what bus it is unless someone happens to be around and can tell me. And I can't travel that way. And getting on and off the bus is dangerous. No one to help me on and off, that's a problem. You look down from up there, you can't see the floor or the gound. You may be stepping in a hole on the sidewalk or it looks the same; the sidewalk and the floor looks the same to me. Ain't no step up as far as my eyes are concerned, but there is see. What do you do in a case like that? I've fell too many times. And Jack would say to me, he's so sweet. He would say, "Now, mother, there's a step here." I said, "Honey, if you hadn't of told me, I wouldn't have known it." Now there you go. So it's not safe for me to . . . and you know it breaks my heart, it grieves my heart out because I can't go. I've been use to going and seeing and...I'm tied down in that small apartment and I can't go nowhere, I can't do anything. They had told me at the Trans-Lift that they would take you shopping. Once in a while you have to have a change of clothes. The driver said yes, they'd take us. I asked headquarters when I called for the ride, no they didn't take you shopping. They would take you to the grocery, but they wouldn't take you shopping. The shopping is just as important and the groceries because you do have to have a dress once in a while or a change of clothes, if you can afford it. I haven't afford it for two or three years. Looks like once in three years I could get me a dress, but I can't get there.

I: If you can't read the paper, how do you know where the sales are?

R: Isn't that the truth. And then I ask somebody to take me . . . they have to do something else, they're going somewhere that day, after saying they would help me all they could. Sometimes, I think of committing suicide. But that wouldn't be good because my daughter's husband did that in California when she was sick out there. I had to go out there. He did that, and it was such a terrific grief, and no insurance either. We had to bury him, and we had to take care of the insurance. And his insurance . . . we had to do it. And I think, well, if I did, then my son would get what little I have left. Maybe that would help him a little along. I do because I don't get enough out of life to keep me going; keep me inspired enough to live. I don't have anything to live for.

I: I hear what you're saying. Well tell me, do you do anything for recreation?

R: This out here is all I have.

I: Out here at the Center?

R: Right here.

I: This is it?

R: This is it.

I: What do you do out here?

R: They give exercise class and a nutrition class, and most of all is being with other people. Getting friendship, and making friends, and seeing people.

I: Meeting somebody new.

R: When I pass one of those offices, it's all I can do from keeping going in there. I'm so used to an office. Thirty-two years in an office taking care of everything and everybody. It just tears my heart out because I can't get in

there and get to work. I feel that's where I belong.

I: Do you reckon you could still type from a tape recording?

R: I don't know, it's been so long. I know I could catch up. And I have arthritis in my fingers, and they're so stiff that I can't.

I: You kind of have to do some exercises, no doubt.

R: It hurts so bad to bend them. They're so sore. What do they call that when it's in the joints?

I: Rheumatoid, is that what they call it?

R: No, it's starts with an O. Osteo____. You know what I mean. And I've often wondered. Now I heard the other day that talk show somebody had a typewriter for sale and I wanted to call in and get it, but I wondered . . . well now, paying out that money. I have others to pay out for, what if I got it and couldn't use it. Of course, I'm used to the keys but its seeing over here what I'm typing.

I: That's what I was thinking. You know, if you had a tape recording that you were listening to, like dictation.

R: I tried that in the mayor's office. I worked in the mayor's office quite some, and he wanted me to use a ediphone, dictaphone. Well I tried that. It just ruined my head. I had headaches so bad that I had to stop, I couldn't stand it. And my daughter was a medical secretary, and that's all she used. A dictaphone after surgery at the Baptist. She was there 3½ years and she was an A-1 medical secretary, and they're hard to find. She died eight years ago. We lived together, just the two children, that's all I had. We lived together, and she died, and I had to give her up, and that's what threw me apart.

I: So now only your son is alive.

R: He comes down. I see him once a week for a short period of time. He has a family, and then he has a job. He works everyday of the week. Works on Sunday, too. But that one day, he gives me a half a day anyway. You see I'm in an awful situation.

I: Well, it sounds to me like your coping. Do you ever go to the church for recreation, you know, like a covered dish supper or anything like that?

R: They have that but I can't cook, I can't do that. I go all the time, and the recreation they don't have in my church, Christian Church. They don't have it in all churches. They have dinners that you take so much of. I can fix that if somebody carry it for me and help me down to the front with it, and I don't like to ask them to do it, and I don't go. They had one last night. I didn't call and ask for transportation. Someone has to volunteer from the church and come get me and bring me back home, and it's way up, way beyond off of Chapman Highway, and they'd have to come downtown and get me and then bring me back. And you know I miss that because I wouldn't ask them to come do it. There's no one that lives near around me that could pick me up, you see. And I miss that--entertainment.

I: If somebody had asked you?

R: If somebody would ask me, that would be wonderful. I would feel like I was welcomed.

I: But you feel like, somehow, you're going to be imposing if you ask, and you know they won't say no because they'll say, well, it's my duty to do that.

R: And they've told me so many times to let them know if there is anything I want. Well, I can't do that. My preacher came down to my house the other day and sat with me quite a while and said, "Now, do you need anything, is there anything we can get for you?" But you know, I wouldn't say, "Yes, go up to the drug store, and get my prescription, it's ready. It's laying up there right now." And I wouldn't ask him to do that, and I wouldn't ask him to come get me and take me to church. Sometimes I think, "Is it worth it?"

I: Now, we have one other question I need to ask you, and that's this. When you plan to go someplace that you've never been before in this city, what are some of the things that you consider before you make that trip? Do you think about whether or not there is a sidewalk there or what kind of weather it is or . . .?

R: I've never had that experience. I don't know. I can't answer that. But I'll tell you another thing that might take the place of it. Being promised to go to these different places, and then they not show up and you dress and you walk the floor and you wait.

I: That's a disappointment, isn't it?

R: Disappointment hurts me, I think, worse than just about anything in everyday life. It may not be serious to a lot of people, but it is to me. It breaks my heart.

I: When you're planning to go out . . . .

R: Get dressed, and wait and wait . . . .

I: And nobody shows up.

R: Nobody shows up. Two Sundays that happened to me.

I: Do they come and get you for church?

R: She's been promising . . . see, she was supposed to come get me, but she didn't, and I couldn't get her at home, and the preacher said, "Why didn't you call me," and I said, "Well, you were already in church, in the Sunday School class, and I couldn't pull you out of that." And the others were, too. If they could have just said one word over the phone saying, "I won't be there." But it's all right. I went downstairs. They have a service down there on Sundays.

INTERVIEW D

I: I don't want your name, but I would like you to introduce yourself for this tape by giving us a little bit about yourself. First, about how old are you, and what is your education level?

R: I'm 30. I have a BA in Business Administration.

I: What section of the city do you live in?

R: I live in west Knoxville within the city limits but outside the business district.

I: What type of residence do you have?

R: An apartment.

I: Who lives with you?

R: Several fish and a dog.

I: So, you're single?

R: Right.

I: Could you describe the nature of your handicap and how long you've had it?

R: I was born with spinal bifida, which is a hole in my spine. So I'm paralyzed from the waist down--almost completely with some function. Some areas, like in my legs, it seems to skip places (like in feeling); I have feeling in my knee but not in my thigh, so it isn't completely cut off at the waist.

I: What is your employment status?

R: I'm senior bookkeeper for Electrical Engineering.

I: Is that a full-time position?

R: Yes, it is full time.

I: Twelve months?

R: Yes.

I: How would you say that your income influences your lifestyle with regard to transportation?

R: Well, monetarily, because I have to watch (I don't make a lot) the gas mileage when planning a trip or even just around town (consolidating trips), saving energy, or whatever it may be; to me it's saving money.

I: But you are able to afford a car?

R: Yes. I probably would have a car anyway, but I'm able to have the car I have because a great aunt who died when I was in my teens left me some money I got when I was 21.

I: So that helps you with your automobile expenses?

R: Yes, I was able to use it to buy a car. Outright. I don't know that now I could afford payments on a car.

I: About how many total trips do you make in a week? And now, I want you to think of trips as each trip one way as a separate trip.

R: You mean, like, if I were going somewhere, that would be two trips?

I: Yes, right, coming to work, for example, would be one trip and then going back home would be another trip.

R: Okay, so I make at least ten trips a week. But I would say I probably make on the average, probably 14, because I try to make most of my routine stops (like grocery shopping and things like that) on the way home from work. So I usually don't go home and get back out again. Usually once I'm home for the evening, I am home for the evening; unless I have a specific activity for the evening. So I would say at least 14, because I'd say there would be at least two other trips per week that I'd make.

I: Now, I gather from what you've said so far that the most frequent way that you travel is by automobile. What would you say would be your next most frequent way of travel?

R: By wheelchair.

I: In other words, you wheel yourself around some. Okay. Do you ever travel by bus, train, airplane, or anything like that?

R: Well, in June, I did fly with my parents to my brother's wedding in Colorado; but that was the first time I had flown in about eight or nine years. Since I've graduated from college, I haven't flown any. Back then I was on crutches so it was easier. I remember one time that I did go from school to home via bus. But I had another car back then, so I usually drove back and forth if I didn't fly or if my parents didn't come to get me.

I: Because of your handicap, what are some of the factors that you have had to consider when you travel to and from work?

R: The time that it takes to get in and out of the car with the wheelchair. The time it takes me to get from the only space that they could assign me where I was able to maneuver my wheelchair out. It's maybe a little farther than most people have to park from the building.

I: Any other factors that you consider about traveling to and from work?

R: Not with work.

I: How about when you go grocery shopping? What factors do you consider?

R: I tend to wait until I really need to go to the grocery store, unless it's just for one or two things and end up with I guess a monthly shopping trip so that I don't have to get in and out of the car that often. I do make as few stops as possible.

I: Are there some grocery stores that you avoid because they're hard to get into and out of?

R: No. That's not really a problem because most all of them have ramps for the carts so--I can't think of one that doesn't. I don't take a paper right now; I used to watch the paper for specials and go to that store. Now I usually go to Kroger's and even though they don't usually

help you with your groceries, they're usually very helpful with me--they carry mine out to my car. Then I have to get them up to my apartment. I usually have four or five bags of groceries, so I don't have to stop very much in between shopping except for milk, or cokes, or something like that.

I: How about factors that you consider when you go to the doctor or for some other medical trip?

R: How accessible it is; like, I have one doctor who practices in two different places and one is closer than the other. One charges for parking and the other doesn't, so I go to the one that doesn't charge for parking, which also happens to be the one that's closer. No, I take that back, the one that doesn't charge for parking is farther away; but the one I go to has a handicapped space on the street that is usually empty and, if not, I can drive around the block and find a spot and even though it's half-an-hour parking limit meters, because of my tags I can park there for more than that.

I: Any other factors that you consider when you go to the doctor or some medical trip?

R: If it's a new doctor--of course, I've been here long to have an established doctor. When I go to new ones, I have to kind of scout it out whether there's a break in the curb to get into; like, I found out that Baptist Hospital is kind of hard to get into--there's a steep incline at one point. I had a doctor that had an office there at one point and an office downtown, so I would arrange to see him downtown even though I had to pay to park (I had to pay to park at both places). The thing was that both places were about the same distance, but Baptist's had the incline in the parking lot. I think they put a ramp in now, but at the time there wasn't one, so I had to wait for someone to help me up the curb.

I: Are inclines quite a problem when you try to get around?

R: Sometimes, yes. Like when I go to the [1982 World's] Fair (I went twice this weekend), I park here at [The University of Tennessee] because I can park for free. I park as close as I can to the green gate, but then I have to go up a pretty steep incline there, and then going in its going down. Then coming back out, I'm tired anyway, and if I had to park too far, it's an awful long way. When you get in the gate, if you want to go to the left, that's a pretty steep and curvy incline to get to the other side of Cumberland.

I: You've partly answered the next question. This summer, one of the things you've been doing is going to the Fair. What else do you do for recreation?

R: Read, watch TV, walk my dog, clean up after my dog.

I: You've described how transportation influences your trips to the Fair in terms of parking. Do you ever go to the movies or things like that?

R: Yes, occasionally. I went to see "E.T." last weekend. It was the first time I had been to a movie in a long time. I have to kind of watch my finances, but my parents were going out (I was over there and they had friends visiting from out of town) with friends and their plans didn't include me, so my father gave me the money to go to the movie. It turned out that it was playing at the closest theatre, West Town. There is no ramp at that theatre as I found out. There were people going in and out so I didn't have to wait long, but I had to wait for someone to help me up the curb and then to help me back down again.

I: Are there restrooms accessible for handicapped?

R: I don't know, I didn't go. Last summer, my cousin was living here, and she and I used to go to the Cinema 6. They had a thing that if we got there by 6:00, I could get in for half price. We would go out there if something interesting was playing. I don't remember using the restrooms but it seems to me that they have a ramp.

I: Can you think of any occasions when you've wanted to do something for recreation where transportation made it not possible for you to do it?

R: Yes. There have been times, not recently, like when I was in college, or I think there have been occasionally since I've been here when I've wanted to go to the lake or camping or something, and there just wasn't room for me and the wheelchair in the car with the other people. I belong to a women's group who will try and carpool to the meetings which are held at different houses each time, and it seems like none of the houses are built to help me much. There are one or two women who can maneuver my wheelchair well enough to get me in. Sometimes when I try to arrange a ride or try to get together several of us from the west end to go east to save gas and so that no one will be taking a long drive by themselves. We usually ended up with this one woman station wagon driving, probably because of the wheelchair. There is usually four of us, and if we use my car, we could take four people, but then there wouldn't be room for the wheelchair. With the station wagon, she can get the wheelchair in the back and the four people.

I: The last question is sort of one that we want to try and get you to think about. Problems that you consider when you plan to go someplace that you've never been before in this city. Kinds of things that you go over in your mind to prepare yourself, I guess, as to whether or not you would make the trip. Can you think of things like that?

R: Well, there's the parking situation, if it would be on the street. I don't usually worry too much about having to pay for parking, that's not so bad. If I'm going, that's not really a consideration. If the only parking is on the street, is it a busy street or is there a place where I can get up onto the curb, is there a driveway, or is it specifically ramped somewhere along the way to get in if I'm going by myself? If I'm going with somebody else to meetings, then I wouldn't have to think about whether it's on a street that's on a hill where I might lose control getting in and out of the car or getting into the store, or if the store has steps to it or something like that where the other person

could help me out. Otherwise, if I were by myself, I'd have to depend on having strangers to come by and be helpful.

I: Do you ever try to get somebody with you if you're going to a place you haven't been before?

R: That usually ends up that she'll just go for me. 'Cause she's pretty familiar with most places and knows whether or not they'll be accessible. And if they are pretty bad, then she'll go ahead and get whatever it is that I need for me. I'll pay her back, or if it's not that much, she gets it for me.

I: Do you ever not go someplace because you're afraid that you might be robbed or mugged or anything like that? A place where that would have been a consideration?

R: Not any more than it would be for anybody else, I think.

I: How about the weather? Is that something you think about?

R: Definitely. If it's icy, I don't even like to drive in bad weather. Rain doesn't bother me unless it's really raining hard, or if I'm not prepared for it, if I don't have a raincoat or something. It can be a problem if I'm going somewhere where I'll be by myself where there's a steep incline outside because my hands get wet and the metal rim gets wet; then I have no traction, so they slide. Even the rain can be a hazard. But my wheelchair doesn't go anywhere in slushy snow. Hardpacked snow is not too bad, but if it has been walked over or kicked around, then I can get stuck. So even if the roads are good enough for me to get out to drive, I have to consider whether the sidewalks are cleared where I'm going.

I: And, on campus, that is not something you can count on.

R: I can usually count on students to help me get to my car and to the building if it's bad enough. Otherwise, I stay home. There have been one or two times when I've came in and nobody else did because it started snowing after I started out.

I: Do you allow yourself extra time to make a trip because of that?

R: I try to. I don't always. It's a family joke that none of us arrive anywhere on time. I try to allow extra time; let's say I were going to church, if the service started at 11:00, I knew it took 15 minutes to get there, I still allow myself an extra ten minutes to get in and out of the car at both ends.

I: Do you go to church quite often?

R: Mmm, not particularly often.

I: The church is accessible, isn't it?

R: Yes. They've put in a ramp at one of the entrances, and I can go through that way into the building (it's not into the front, but it's pretty much available); but there is one entrance that I can use.

I: Do you ever get concerned about going to a section of the city that's pretty crowded, a lot of people on the sidewalks, that kind of thing? Do you ever think about that?

R: You mean when I'm on the sidewalk? Not really. Like at the Fair, it got pretty crowded. I used to be pretty claustrophobic about crowds when I was on crutches, and it carried when I had to start using the wheelchair, and I had some back surgery that kind of backfired. It straightened my back out but it put my pelvic structure at a different angle, so it pulled my hip out of the socket when I tried to walk with my crutches and braces again. When I tried to walk, I went to crutches and braces. So I had more back surgery. The doctor broke my leg and my hip and reset it, hopefully in a correct position where it would stay in, but it didn't work. So I decided I would stay in a wheelchair. It was also a hassle to get back the strength I had when I was on crutches and braces. When I was on crutches and braces, I was pretty afraid of knocking someone over or, mostly of being knocked over by somebody close by, so I'd stay away from crowds. I was very dependent on the crutches, so it wouldn't take much for me to fall over. It's been eight years now, so I've pretty much gotten out of that to where it really doesn't bother me to be in crowds.

I: Your car, then, you operate totally with hand controls: hand brake and hand accelerator?

R: I just pull up on the lever for the accelerator and push down to release the _____ and on the brake.

I: Sounds very convenient.

R: Except when it breaks.

I: Do you have much problem with it breaking?

R: No. The piece has broken twice. I shouldn't really complain because I've had these hand controls for 14 years. A couple of years ago, some bolt or something sheared off, while I was on the Interstate and I couldn't use the accelerator. So I pulled over and, luckily, someone came along who knew me and was able to get a hold of my father. No, I forgot, that was the time the police brought me home because they couldn't get a hold of my parents. My father went and got the car and fixed the bolt. Almost a year later exactly, the same thing happened again, but he got a better bolt and it hasn't happened again. Luckily, he said it probably wouldn't happen to the brake because it works in a different way. The bolt had some pressure on it in the position it's in, and he evidently did not put in one that was heavy duty enough the first time it happened, so he got one that was specially hardened somehow to put in the second time.

I: Well, listen, I really appreciate the time you have taken with me. Do you have anything else you would like to say about transportation?

R: I can't really think of anything else. That pretty much covers it.

INTERVIEW E

I: I need to get a kind of a biographical introduction . . . basically age, education, and residence, location . . . that kind of thing.

R: Okay, I am 35. I live at . . . well, do you want the city or . . .?

I: Well, basically what part of the city, and whether it is . . .?

R: Okay, well I live in northeast Knoxville.

I: Do you live near the bus route or . . .?

R: On the bus route.

I: How much education did you have?

R: Master's degree.

I: What area?

R: Social work.

I: In what type of residence do you live in? A single family dwelling?

R: Single family.

I: Who lives with you?

R: I have a driver aide that lives with me.

I: And your marital status is single?

R: Yes.

I: Now, nature of handicap?

R: I am a C-5 quadriplegic.

I: And how long have you had the handicap?

R: Nine years.

I: And your employment status?

R: I am employed as program director at the Cerebral Palsy Center.

I: Full time?

R: Full time.

I: How would you say your income influences your lifestyle with regard to transportation.

R: I say it makes it all possible. With the level that I am employed, it isn't the greatest, but at the same time, it allows me to put the extra money into owning a van with a wheelchair lift and to work out a way that I can have someone live with me that can drive me to work and back and other times during the week, so that it does make all my transportation possible that way.

I: How many total trips do you make in one week, if we were thinking about one-way trips?

R: Okay. There is ten to employment. Probably six other outside of that that are mere recreation and shopping.

I: And your most frequent mode of travel is your van?

R: That's right.

I: Do you have another mode of travel that you use?

R: I can get in and out of other people's cars, but I rarely use that. I mainly use the van because it's so simple.

I: Do you do any wheeling at all?

R: No, I can't; my strength. I can go for short distances and things like that, but not more than a block, and the hills and being able to stop and go up and down them, it's really difficult for me.

I: What factors do you have to consider when you travel to and from work because of your handicap? Any particular ones?

R: You mean with the way I am traveling now?

I: Yes.

R: Well, mainly you know, my route is pretty much predetermined by the time both of us have to be to work. For example, I get here at 7:30 in the morning when the work day starts at 8:30. I leave at 5:30 when it ends at 4:30. So it's those kinds of things.

I: Just an adjustment in schedule because your working on two people's schedules, like a carpool.

R: Right. So that is about the biggest problem. You know, as far as entry and exit and everything, I don't have to worry about that like I do when I go somewhere else.

I: Would you describe what factors you consider when you go grocery shopping?

R: Yea, I really worry about parking, the handicapped parking spaces, where they are in relationship to the grocery store and how easy it is for me to get in and out and pretty much independently, because whenever I go, the other person is worrying about the cart and the groceries and all that. Also, the new trick is the checkout aisles aren't wide enough, so when I find a grocery store that has checkout aisles wide enough that I can go through and get out and without having to go all the way back around the store and back out the far end, then I would go there a lot more.

I: That's right. They have reduced the size of those checkout aisles. I was noticing that the other day.

R: They are a lot tighter. Most of them I can't get through, you know, so that matters. And you know the crowd flux. I generally go shopping late in the evening just to keep from . . . because the wheelchair and the grocery carts just don't get along in the aisles. Those are the kind of things I tend to . . .

I: What factors do you consider when you go to the doctor or some other medical trip?

R: Mainly it's the, again, the handicapped parking and it's the ease in getting into the building. Also there is a lot of things like, once I get in, like, you know, whether they are able to handle me or whether the doctor himself will lift me on the examining table, or whether they have someone there that can do those kinds of things. But primarily, that's it outside of the quality of the doctor, you know. I guess that's one of the biggest, but I'll go through rougher times to see a better doctor. But generally, most of my doctors now are ones that I know I can get in and out very easily and no problem. But the parking, you know how close it is to the office and how much help I'm gonna need getting in and out. But, mainly, it is the availability of someone driving me. Like, I had a medical appointment scheduled for August, and I wasn't able to keep it until just this last week before this.

I: Simply because of the problem of having a driver?

R: Yea, because my driver had been working a lot of overtime and couldn't get away from his job. Doctors only open on bankers' hours, so you know it's those kinds of problems, and it took a long time to be able to work it out to get someone else to take me.

I: What do you do for recreation?

R: Um, well, now that the World's Fair is gone, not much. I made about 30 trips to the World's Fair. Generally, going for rides, friends' houses, parties, going out to eat. I go out to eat quite a bit, so those are kinds of things.

I: Are there factors that you consider there?

R: Always, yea. It's always the same thing. It comes down to the ease of getting out of the restaurant.

I: Accessibility?

R: Right. Generally, if a new restaurant opens, I send somebody ahead because my friends are now tuned into, oh, it doesn't have any stairs, and it's one level, and you can get around, and the tables aren't really low, and these kinds of things, and I don't have to, you know, worry about that. Now, it's not gonna hold me back from trying if I've got two or three friends going with me. I know we can get over most obstacles. Two or three stairs isn't even too much. But I tend to really . . . it doesn't restrict my choices, but it also, you know, affects them.

I: Were most of the eating places at the World's Fair pretty accessible?

R: Oh, I had no trouble at the World's Fair. I thought that was as, you know, as much as they were ballyhooing, it was one of the easier places I have gotten around. You know, they were more accommodating and everything seemed to work. It worked perfect for me . . . that's why I enjoyed it so much.

I: Because you have the van and the driver, you basically always have transportation available?

R: Yea. I do have my LIFT card and everything so that, if he's sick or there are problems . . . see I just moved into town full time in August. I have been in Lenoir City. I would have sat home and rotted if things didn't happen. Now that I am in Knoxville, so really, it hadn't really been enough time for him to get ill or something to go wrong, but I have it all set up that if I need it, I can go ahead and call them to get to work and things like that.

I: What are some problems that you consider when you plan to go someplace that you haven't been before in Knoxville? For example, do you let the weather influence you?

R: No, the weather doesn't bother me at all. You know, even a steady rain, you are used to getting wet . . . I mean it's one of the things I finally gave up on . . . I don't worry about. Mainly, the kinds of things I worry about again are curbs, stairs, hills, you know, who's going with me, will he be able to handle me and, you know, those kind of situations. You know, it tends to really . . . and new places I haven't been before, of course, create more anxiety because, you're at the restaurant, and you fit, and they have to start making all these different accommodations, you get kind of embarrassed because everybody is watching you.

I: So getting in and out of the place is one and getting around inside the place would be one. Sidewalks, I suppose?

R: Yea, even the condition of the sidewalks. You know, there is some up around campus where you go downtown, some of the curb cuts up there are just terrible pains. They are some of the first that they've ever done, and, you know, we will try to work out ways of parking and to avoid those, because we don't want to go down through that corner . . . that's the killer and things like that.

I: How about restroom facilities?

R: That is never a concern for me because I, you know, don't ever have to use, you know, a public restroom. I have a leg bag and things like that I use, so there is never much of a need for the facilities, although, you know, there is times when I have to and generally they're not, so it doesn't work out well.

I: Do you have to carry any medication or other essential equipment that are related to your handicap that makes it difficult for you to travel?

R: Yea, like when I come to work and things, I generally carry a wallet, a checkbook, an arm brace, and maybe a book I'm reading or something like that, and they slip, slide, and fall everywhere, and I have never really found a way of carrying a bag or satchel that I can get in and out of. Generally, I put them all in a paper bag, but it slides even more so, so it is difficult carrying things 'cause I don't have that good of hand control. So when they start to slide, I can't just grab them, or I can't hold them as I ride.

I: Do you ever consider the cost of the trip when you . . .?

R: Not really.

I: Getting transportation back from the place where you go; you usually take it with you, so no problem there? How about getting robbed or mugged? Has that ever happened?

R: Never.

APPENDIX D

LATENT TRAVEL DEMAND FOR ALTERNATIVE TRANSPORTATION SOLUTIONS BY MARKET SEGMENT

The results of the UMTA national survey of transportation handicapped persons provide a way of estimating the latent travel demand for alternative transportation solutions by different market segments.

Table D-1 shows the additional trips per person per day that would be taken by transportation handicapped persons if an ideal transportation service were available. The latent demand of moderately transportation handicapped persons who usually do not have cars available is 1.095 times the latent demand of all handicapped persons who usually do not have cars available. Likewise, the latent demand of severely transportation handicapped persons with limited access to cars is 0.857 times the latent demand of all handicapped persons with limited access to automobile transportation. These factors were assumed to apply as well to handicapped persons who usually have cars available. Thus, the latent travel demand of moderately transportation handicapped persons who usually have cars available was estimated to be:

0.03 x 1.095 = 0.033 additional trips per person per day

Table D-1. Latent Travel Demand for an Ideal Transportation Service[a] by Market Segment.

Market Segment	Additional Trips per Person per day
Handicapped persons who usually have cars available	0.03
Handicapped persons who usually do not have cars available	0.21
• Moderately Transportation Handicapped Persons[b]	0.23
• Severely Transportation Handicapped Persons[c]	0.18

[a]An unspecified, hypothetical means of transportation that would solve all of the transportation problems of the transportation handicapped individual.

[b]Persons who can now use public transit.

[c]Persons who cannot now use public transit.

SOURCE: Ref. 19. The statistics were compiled by the Congressional Budget Office from U.S. Department of Transportation, Top-Line Presentation of Transportation Handicapped People Who Do Not Have a Car Available and Who Do Not Use Public Transit, February 1979.

For severely transportation handicapped persons who usually have cars available, the latent travel demand was estimated to be:

0.03 x 0.857 = 0.026 additional trips per person per day

In Table D-2, the total latent travel demand for several alternative transportation solutions is compared to the total latent travel demand for an ideal transportation service. The percentages in this table were assumed to apply to each of the market segments as well as to the entire transportation handicapped population. Thus, the latent demand for an accessible fixed-route transit system by severely transportation handicapped persons who usually do not have cars available was estimated to be:

0.180 x 0.235 = 0.042 additional trips per person per day

In a similar fashion, the latent demand of the other market segments was determined for each of the alternative transportation solutions. The results are given in Table 28.

Table D-2. Latent Travel Demand for Alternative Transportation Solutions Relative to an Ideal Transportation Service.

Alternative Transportation Solution	Additional Trips per Person per Day[a]	Percent of Ideal Latent Demand
Accessible fixed-route transit system	0.031	23.5
Specialized door-to-door transportation system	0.066	50.0
Individual subsidies to pay for better transportation	0.100	75.8
Ideal transportation service	0.132	100.0

[a]Obtained by dividing the total number of additional trips per month by the total number of transportation handicapped persons. The results were then divided by 30 to convert to trips per person per day.

SOURCE: UMTA National Survey of Transportation Handicapped People, Ref. 8.

RD is an agency of the National
iences and the National Academy
h concerning the nature and per-
on that the research produces, and
s. The Board's program is carried
ls composed of more than 3,300
ators, and others concerned with
am is supported by state transpor-
of the U.S. Department of Trans-
National Highway Traffic Safety
interested in the development of

National Research Council. The
Academy of Sciences in 1916 to
with the Academy's purposes of
nent. The Council operates in ac-
under the authority of its congres-
private, nonprofit, self-governing
cipal operating agency of both the
of Engineering in the conduct of
ific and engineering communities.
ute of Medicine.

3 by Act of Congress as a private,
herance of science and technology,
its fields of competence. Under its
arch Council in 1916, the National
cine in 1970.

TRANSPORTATION RESEARCH BOARD
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

ADDRESS CORRECTION REQUESTED