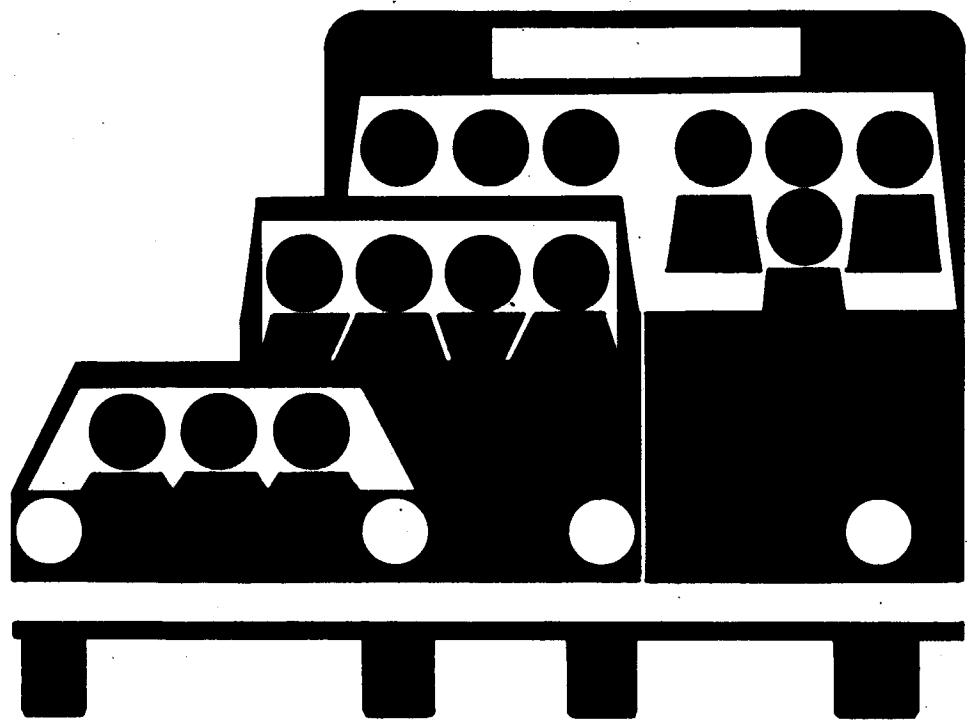


Review of Carpool Activities

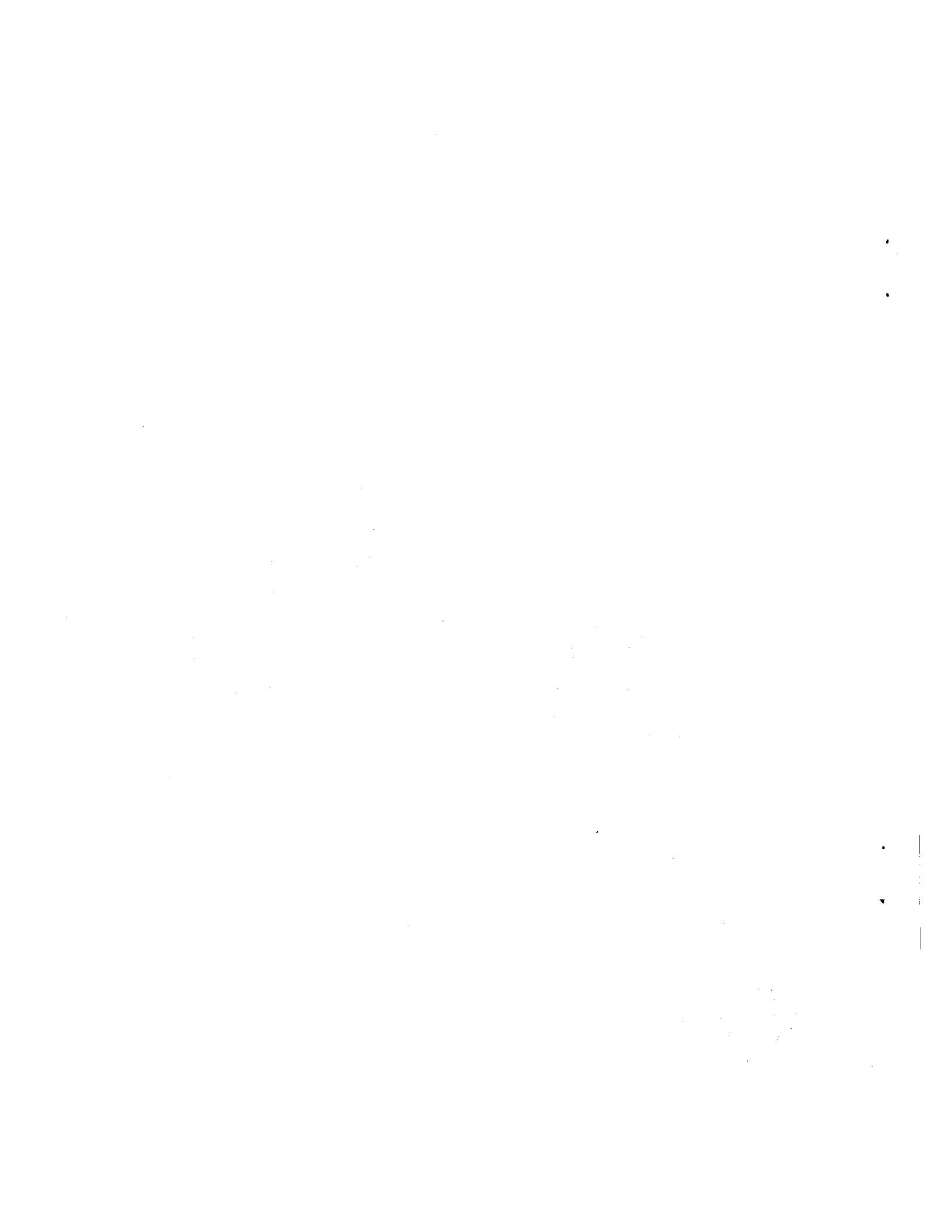


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U.S. Department of Transportation

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NATIONWIDE CARPOOLING ACTION PROGRAM

Review of Carpool Activities

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FINAL REPORT

Prepared for

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PREFACE

This report is one of a series dealing with various necessary ingredients for a successful Carpool/Buspool Program. It was developed by Alan M. Voorhees and Associates, Inc. for the United States Department of Transportation.

The goal of a Carpool/Buspool Program should be to satisfy travel requirements more efficiently by increasing passenger occupancy in autos and buses, thereby reducing the number of vehicles using the streets and highways. Achievement of that goal calls for coordination among many institutions within a metropolitan region, including public agencies and citizen and business groups. Participation by all of these groups and their knowledge of necessary program elements are critical to the success of the program.

The information and techniques presented in this series of reports should be considered as a guide to the development of a sound program in a metropolitan area. The program should be designed to make the existing street and highway system more efficient, to have a significant effect relative to energy conservation, and to foster urban and environmental goals.

The other reports prepared as part of this series, as well as other important documents concerning carpooling and buspooling can be obtained from the U. S. Department of Transportation.

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	1
MAJOR CARPOOL ACTIVITIES	2
Motivation of Organization Involved	2
Manual Carpool Matching Methods	3
Computerized Carpool Matching Methods	6
Incentives for Carpool Programs	9
Public Information Activities	15
Significant Integrated Carpool Programs	17
SPECIAL CONSIDERATIONS IN CARPOOLING	21
Organization for Carpooling	21
Legal and Institutional Issues	21
Coordination with Transit and Taxi Operations	22
Special Mobility Problems	23
Back-Up Systems	23
AUTOMOBILE OCCUPANCY IN THE UNITED STATES	24
Work Trip Occupancy	24
Occupancy for Other Trip Purposes	25
Major Factors Influencing Carpools	25
Characteristics of Carpoolers, Potential Carpoolers and Non-Poolers	30
Reasons for Not Pooling	32
CONCLUSIONS	33
REFERENCES	36

REVIEW OF CARPOOL ACTIVITIES

INTRODUCTION

This review describes and discusses the current state-of-the-art of carpooling in the United States. It has been prepared as an aid to businesses, institutions and organizations that wish to form carpools and need to know what others have done and are doing in the field. It is not a "how to" document. Rather, it attempts to put carpooling in the perspective of the nation's current energy crisis--a crisis that is having a profound effect on our familiar wasteful patterns of travel.

In addition to pooling in autos, significant activities in vanpooling and buspooling programs are also covered. These efforts are closely related to carpooling serving, in essence, as higher occupancy modes of ride sharing. A well rounded attack on low vehicle occupancy should involve all three classes of pooling, each being brought to bear where it can serve most effectively.

Not since World War II has there been such a high degree of interest in carpooling. And not since World War II has there been such a need for this activity. Though there are many dramatic differences between today's situation and that of World War II, both share one element of crisis: a critical shortage of petroleum products. During the war, people in great numbers responded to the crisis by forming carpools, either voluntarily or in conformance with government regulations. The greatest progress made during the war period was in the industrial categories where automobile occupancy for work trips rose from an average of about 2 persons per vehicle prior to July 1, 1942 to approximately 3 per car by March 1, 1943.⁽¹⁾ Today's typical average work trip occupancy rate, ranging from 1.2 to 1.6 persons per vehicle, offers us a real challenge to respond equally as well to our current national crisis.

This report is based on a quick but intensive review of carpooling activities throughout the country. It represents, first of all, an overview of carpooling programs and activities that now exist in the United States--who is engaging in carpooling, how the individual programs are being operated, and the successes and failures that are being encountered. This discussion is followed by a brief description of automobile occupancy in the United States--what it is, what factors affect it, and what attitudes are relative to carpooling. A conclusion summarizes the current state-of-the art and lists the ingredients that are essential to the success of any carpooling effort.

This review indicates that carpooling and buspooling in the United States shows promise of becoming a vital and effective way of responding to the national energy crisis. It is hoped that the programs described in this review will encourage and inspire many others to participate in any activity that promises to be a key factor in coping with an immediate crisis situation that affects the lives and well-being of all of us. During this coming period much can be learned about how best to weave carpooling and buspooling more permanently into the national transportation fabric.

MAJOR CARPOOL ACTIVITIES

The national energy crisis, with its prospect of a serious gasoline shortage, has inspired a recent dramatic increase in the creation of carpool programs in all segments of the country. Before the onset of the crisis, carpooling was not a widespread activity in the U.S.

In view of the relatively low level of previous formal carpool organizing activities, it is clear that the vast majority of carpooling practiced today is the result of individuals matching themselves up without assistance or externally applied incentives.

The intent of this section is to review the significant carpooling activities going on in the U.S. -- those that are well-established as well as the major ones that have been formed as a result of the energy crisis. This discussion is divided into the following major elements of carpooling programs:

- Motivation of organizations involved
- Manual carpool matching methods
- Computerized carpool matching methods
- Carpool incentives
- Public information activities
- Miscellaneous activities

Motivation of Organizations Involved

The vast majority of formal carpool programs, whether they were formed before or after the onset of the energy crisis were initiated by employers. In many instances the successful programs were motivated by shortage of parking spaces for employees. Most of these

matched fellow carpoolers either by hand or through simple computer programs. They usually offered no incentives to carpoolers except, in some cases, preferential parking in the employer's lot. Virtually all of them were work-oriented. A few programs, however, involved the matching of carpoolers for specialized activities such as ski trips and special events. These programs have usually been initiated without reference to the energy crisis or other external influences.

Some of the newly created carpool programs are attempting to be more responsive to commuters' needs and therefore are broader in their application. These involve major sponsors, such as state highway departments, regional organizations, and radio-television stations, which attempt to match individuals throughout a wide area from a central location, using more complicated computer techniques. Many of them also encourage major employers in the area to form their own carpools, offering them guidebooks and other materials as aids. Because of their broader base, these programs must be promoted through the mass media, using announcements on radio and television and advertising and publicity articles in newspapers.

Activities initiated in the very recent past, in the context of the energy crisis, have been directly motivated by the plight of the driver -- his difficulty in getting enough gas, or affording to pay higher prices for gas.

Manual Carpool Matching Methods

Manual matching refers to the methods and techniques used to form potential carpools without the aid of a computer. Manual methods are in more common use than computer-based methods and they are not always confined to small groups of potential carpoolers. The Hallmark Card Company in Kansas City, for example, used a manual method at a plant that employs 4,500 persons. Generally manual techniques can be implemented quickly at a low cost. Sometimes manual techniques are preferred over computer-based techniques because of "employee acceptance." Apparently, some people prefer to have as little personal information as possible on computer tapes. Manual methods should be considered as the first step in a matching process for any organization with fewer than 1,000 employees. This can be done without retarding development of a computer technique if common data forms are used.

Although there are many variations in the manual matching methods used throughout the country, most can be categorized as one of two basic techniques:

Supervised Questionnaire Techniques - Using questionnaires filled in and returned by employees, or in some instances personnel records, a carpool supervisor matches potential carpool partners by manual methods using similar procedures as those of a computer matching program. Potential carpoolers are grouped by residential location and working hours. The employees are advised of those whose work trips are closely matched in time and space. Occasionally, this process is performed with the aid of an automatic card sorter or simple sorting systems such as edge punched cards.

Locator Board Technique - This technique uses locator boards placed at convenient locations in plants or office buildings and frequently operates as a self-service system. Possibly the oldest matching technique, it has been used by the Federal Government in Washington office buildings and by McDonnell-Douglas in its St. Louis plant for many years. Generally, locator boards have a regional map with superimposed grids which potential carpoolers use to locate their residence. Once located the appropriate square is noted on a registration card, or sometimes a numbered map tack is stuck on the map board at the place of residence. Pins can be coded to indicate the characteristics of the potential carpooler (work hours, rider/driver, etc.) and can be numbered to keep the name of potential carpoolers confidential. Sometimes a box with pigeonholes corresponding to each grid square is used to file the registration cards. This technique can be used by itself or to maintain a carpool program after initial, centralized carpool matches have been made. One of the limitations of the locator board system is that the board is installed in one place in the facility and all persons interested must visit that location. When two or more boards are used in the same facility, the potential for efficient carpool matchups is diluted unless a central coordinator is actively involved.

A separate report in this series titled Manual Carpool Matching Techniques contains more detail on specific techniques and recommends the steps required in organizing and managing a successful system.

Examples of Manual Matching - Following are descriptions of three selected manual matching activities.

- The Hallmark Card Company is an example of a large corporation which used a manual matching method to get a carpool program working in a relatively short time. Several months ago Hallmark experienced a

parking supply problem that management felt could be solved with a carpooling program. A survey was conducted of Hallmark's 4,500 employees on all three shifts. On the return card employees indicated their desire to carpool and their addresses and zip code. To insure employee confidence, long-term trusted employees were assigned to handle the returns, the subsequent matching and general problems. A centralized manual matching process resulted in an expansion of carpools which substantially alleviated the parking shortage.

The formation of the carpools was accomplished by furnishing lists of potential poolers to those interested. As an incentive, a reserved parking space was provided to each carpool. The fact that Hallmark is now converting to a computer-based system suggests that for an organization of this size a manual matching method may not be a permanent solution. This conversion also illustrates the wisdom of designing employee data forms in the initial manual matching process which are compatible with a computer-based system.

- NASA Carpooling System - Another significant manual matching method has been operated by the National Aeronautics and Space Administration since 1964. The activity was initiated because of the scarcity of spaces at the NASA headquarters and the high cost of nearby private parking. Members of carpools must fill out a form entitled "Application for Official Parking Space." Spaces are assigned according to a point system based on the number of members in a pool, their government service grade, and their years of service. The manual matching technique used for the program involves a card catalog system, a visual wall display, and a periodic (6-month) survey of carpool members. All carpool members are listed alphabetically on index cards, which show the individual's name, his permit number, and parking location. Program applications are filed by permit number in notebooks for cross-reference and as a supplement to the visual display board. The board is used to match potential carpoolers either with new carpools (shown in red) or with existing carpools that have a vacancy (shown in green). If a carpool can't be

accommodated through use of the visual display, employees can contact the program administrator who uses his card catalog system and permit records to aid them. Administration of the program requires about 20 percent of the administrator's time and a week of secretarial time every six months. About 800 NASA employees ride in officially registered carpools, and the average occupancy in these vehicles is 3.85 persons.

- Vienna, Virginia System -- Both of the previous examples illustrate how manual methods are used by major employers. Application of these methods can be broadened to home-based matching. This is illustrated by a carpool program started by the Town of Vienna, Virginia, a four-square mile community in the Washington, D.C. suburbs. In the summer of 1973, the town conducted a survey in which questionnaires were distributed to some 5,000 residents. Using volunteer workers from the Junior Chamber of Commerce, survey results (25 percent return rate) were processed manually. A grid was superimposed on a tax "map" of Vienna and trip origins were located by grid cell using a color-coded tag for each potential carpooler. At the same time, a grid designation was overlaid on a map of Washington and destinations were identified. Calls were then made to groups of residents who worked in a common area and had compatible work hours. Individuals were contacted until one was found who was willing to take the initiative and contact others in his or her group. No follow-up monitoring has been pursued so no data exist regarding the efficiency of this program.

Computerized Carpool Matching Methods

The formation of carpools frequently involves the processing of large amounts of data. Information about each potential carpooler must be examined, categorized, and assigned to potential carpools. Thus the problems of carpool formation lend themselves to computerized methods when the number of potential carpools is large. Computer methods should be seriously investigated by any group with more than 1,000 potential carpools. A considerable number of computer programs have been developed by organizations of all types and used throughout the country to perform carpool matching. These efforts

have tended to be independent and uncoordinated. While many of the programs are quite simple and designed for specific applications, many are designed for multiple applications. These latter programs are written in a generalized format with accompanying user documentation.

All of the computer methods in existence require substantial clerical and management efforts in data collection, preparation, information dissemination, and continuing system operation. Users who are planning computer matching programs too often overlook or underestimate the level of effort required to support such a system.

Examples of Computer Matching - The most widely distributed carpool matching computer program is that developed by the Federal Highway Administration. (2) It has been obtained by a large number of organizations and at least 50 groups are now using the FHWA program or modifications of it and well over 100 groups have requested tape copies of the program. Because the program is written in COBOL computer language, many users have found it possible to modify it somewhat to make it operational on their own computer. The program is based on a grid system and is designed primarily for application at places of employment. It produces not only individual carpool matches but also a density matrix for use in identifying buspool demand.

Although the FHWA program is the most widely distributed matching program, and probably the best documented, there are a number of other generalized computer matching programs that should be mentioned. The most significant of these include programs developed by:

- Washington COG Program -- Developed by the Washington Regional Council of Governments, this program has received considerable use in the employer-based carpooling efforts of the Northern Virginia Transportation Commission (NVTC). Working at a census file level, the program produces lists that group commuters who live no more than a specified distance from one another and who have compatible work schedules.

- UCLA Program -- This program written in FORTRAN IV can be used for developing employer-based carpools for any institution in the Los Angeles Metropolitan Area. Residential locations are specified by a coordinate system coded manually before keypunching. Although it could be modified for use anywhere, thus far it has been used in Los Angeles by UCLA.
- CALTRANS Program -- This FORTRAN program uses Lambert coordinates as its method of geocoding. Only recently developed, it has not been applied to date. Special attention was devoted to the design of file maintenance techniques which permit efficient updating.
- COMPUTRANSIT Program -- A proprietary product of COMPUTRANSIT, this PL/1 program uses a grid system for geocoding. Although it has not yet been used in an actual carpool matching effort, the program has been tested with simulations of up to 2,000 randomly generated commuters.
- U.S. Census Program -- This program, which is written in multiple languages, uses geographic base (DIME) files to locate addresses at the census tract level. It is currently being implemented by the County of Los Angeles.
- American Academy of Transportation (AAT) Program -- A nonprofit organization, AAT has written a very promising matching program. Written in FORTRAN, the program uses coordinates for geocoding. It has been used to form carpools for several major employers in the Detroit area.
- Operation Oxygen Program -- Written by a volunteer, nonprofit organization with major assistance from Burroughs Corporation. Variations of this program have been used by many California groups including five Los Angeles banks with 1,000 commuters in a common data base. It is written in COBOL and uses a grid system for geocoding.
- Connecticut DOT Program -- The Connecticut Department of Transportation has developed a program unique in that it covers an entire state. Geocoding is conducted at the township level. It is currently being applied in New Haven and has already been applied at several other locations in the state.

- Aerojet Program -- A proprietary product of Aerojet Corporation, this FORTRAN program uses a grid system for geocoding. The program is currently being used as part of a carpooling effort for Aerojet employees.
- George Washington High School Program -- Students at this Denver High School and their advisors have developed a matching program that has been used for a number of major employers in the Denver area. The program is written in FORTRAN and uses a grid system for geocoding.

A detailed discussion of computer matching techniques is presented in a separate report titled Review of Matching Software and Procedures.

Incentives for Carpool Programs

The recent history of carpooling goes back primarily to the era when environmental issues were of more significance than the energy crisis and the basic incentive was to reduce air pollution. Since the advent of the energy crisis, several special incentives have come about which are being used by many groups in carpool formation. It should be noted, however, that many carpool programs, perhaps the majority, offer no special incentives for carpools whatsoever.

A separate report, Incentives to Carpooling, describes in detail the incentives being offered by specific groups. Thus, this report will highlight only some of the findings. Incentives can be classified into three major categories related to the basic motivations which are addressed:

- Cost-Related Incentives
- Travel Time Incentives
- Convenience Incentives

Cost-Related Incentives - These incentives either reward the carpoolers by reducing their travel-related costs or increase the cost to non-poolers. The most frequently employed and most powerful incentive is parking cost subsidization wherein the employer pays for all or part of the cost of parking for carpoolers, but not for non-poolers.

Another significant cost-related incentive is the provision of company owned or sponsored cars or vans for use as commuter carpools. This

gives the carpooler a significant saving in vehicle operating cost, because costs are spread over more occupants, but also may allow a reduction in household auto ownership expenses. The 3M Company has an especially successful company owned vanpool system at its headquarters in St. Paul, Minnesota. The following descriptions are selected examples of significant cost-related incentives:

- Prudential Insurance Company (Boston) -- Prudential provides employees who carpool in groups of three or more with free parking in the company-owned garage. The normal parking fee is \$2.50 per day. Presently 44 percent of the employees are carpoolers and demand for the free spaces is threatening to exceed the available supply.
- Port of Portland (Oregon) -- On December 1, 1973, the Port of Portland instituted a program to increase both carpooling and transit usage among its 300 employees. The program provides the following incentives: for carpools of three or four (including the driver) the Port will pay the \$10 monthly parking charge; for carpools of five or more (including the driver), the Port will pay the monthly parking charge plus 11 cents per mile; and for transit users, the Port will pay up to 70 cents per day for bus fares. Approximately 25 percent of the employees are riding in buses and carpools. Some criticism of the program has been encountered, however, because of the use of public funds to subsidize the commuting cost of a few "privileged" Oregon residents. As a consequence the program has attracted considerable local publicity and controversy.
- 3M Vanpool Project -- The 3M project merits special attention under incentives. Although its primary incentive is cost-related, it provides a unique combination of incentives to encourage its employees to use vanpools. As a pilot test of the vanpooling concept, 3M has conducted a small-scale vanpool demonstration project using six company-owned vans. Groups of 8 to 11 employees have been organized to ride each of the "commute-a-vans" regularly. At least two of the members serve as drivers, including the van coordinator who has responsibility for arranging for servicing and maintenance of the van, fare collection, keeping ridership

at or above the minimum occupancy of eight, and training back-up drivers. The pool coordinator gets a free ride plus all passenger revenues exceeding the minimum of eight passengers. Riders' fares are paid monthly and are computed on a break-even basis (including ownership costs) covering the round-trip mileage of each vanpool. The cost on which the fares are based ranges from 83 cents per person for a 10-mile round trip, to \$1.45 for 100 miles. The pilot program was very successful and the vanpool system has been expanded to 40 vans and 600 employees have requests on file to join the system. These results are especially significant because the 3M Center is situated in a suburban area where traffic problems are not as severe as typically experienced in central areas.

To a large extent, the success of the program appears to be due to the fact that the drivers run the program and are rewarded for doing so. All the company does is provide the means for operating the system (vehicle purchase, fare collection and payment of expenses) and communication (records for interested participants and drivers, screening and selection and training of drivers). Drivers must be responsible for organizing and running the vanpool system, and for this they must be provided incentives. The incentives for drivers include:

- Free ride to work
- Unlimited personal use of van during off-work hours at the rate of seven cents per mile
- Fares collected over operating expenses (for average 25 mile-round trip, this amounts to about \$2.00 per day for full occupancy)
- Status and recognition; selection for vanpool driving is considered recognition of employee's worth and leadership attributes
- Drivers get first option for buying vans retired from service. To the extent possible, drivers are given the option of selecting the make and color of the van for their pool

Incentives for riders include:

- Savings in travel expenses and elimination of need for a second car (except for executive vanpool park/ride)

- Preferential parking close to building
 - Useful traveltime for other than driving (work, conversation, card games, etc.)
 - Social aspects are emphasized: new friendships form, riding is enjoyable
- Vehicle Usage -- A number of City and State agencies throughout the country are making state-owned vehicles available for carpools, thus providing riders a significant travel cost savings. The Arkansas State Highway Department in Little Rock requires that all state-owned vehicles taken home at night by employees have a minimum of three carpool riders. In some areas carpools must be formed entirely of state or city employees while in other areas a limited amount of usage by non-state employees is allowed.
 - Ski-lift Ticket Discounts -- In Colorado a private, non-profit organization, Colorado Ski Country, organizes weekend carpools to the Colorado ski areas. Some of these ski areas are offering lift ticket discounts to carpools. Similar programs are underway in Utah and New England.
 - The Golden Gate Bridge, and Highway Transportation District in San Francisco leases buses and drivers to members of "Commuter Clubs." Each club solicits its own members, collects the dues, and makes monthly payments to the District. The District sets the fares so that costs are met fully when all seats on each bus are used. Until then, the District subsidizes the club. The minimum number of seats required to start a club is 30. Routes and schedules are established by each club. The program, which began a year ago with one bus, now has three buses serving about 100 persons. Insurance is provided by the District.

Travel Time Incentives - The primary type of travel time reduction incentives is priority traffic control techniques, of which there are a wide variety. Incentives of this type grant time savings priority to carpools and buses and at the same time, in some cases, penalize with excess delay the low occupancy vehicle. Important priority traffic control techniques include:

- Exclusive (separated) Freeway Lanes -- Exclusive lanes for buses and carpools of 4 or more persons are used on

the Shirley Highway in the Washington, D.C. area. Approximately 15-minutes are saved during the peak hour.

- Reserved Freeway Lanes -- for buses and carpools are being implemented in Miami and may move ahead quickly in Los Angeles.
- Contra-Flow Freeway Lanes -- for buses only are operating in several cities. The most successful is on the I-495 approach to the Lincoln Tunnel in the New York metropolitan area. Approximately 40,000 bus passengers are served and delay is reduced by 8 to 15 minutes.
- Priority Ramp Metering -- is being successfully operated at one ramp in Los Angeles. Carpool vehicles with 2 or more persons can bypass the entrance ramp queue and save 7 to 9 minutes during the peak hour.
- Reserved Toll Plaza Lanes -- for buses and carpools are used on the Oakland Bay Bridge in San Francisco. Delay reduction during the peak hour is about five minutes and the number of carpools with 3 or more persons has nearly doubled.

Convenience Incentives - This class of incentive is designed to appeal most directly to the commuter's sense of comfort and his perception of the ease of commuting. Convenience measures often overlap with cost-related and travel time incentives. The methods may be either positive or negative, i. e. they may either increase the convenience of carpooling or decrease the convenience of non-pooling, or both. Important convenience incentives include:

- Preferential parking space allocation
- Special park-ride lots for carpools and buspools
- Special working hours adjustments
- Banning of low occupancy vehicles in certain areas
- Parking supply reduction

Presented below are selected examples of convenience incentives.

- National Aeronautics and Space Administration (Washington, D.C.) - - As mentioned previously, NASA's Washington headquarters assigns reserved spaces to carpools according to a point system based on the number of members in a pool, their government service grade, and their years of service.
- U.S. Department of Agriculture (Washington, D.C.) -- The Department uses a point system similar to that used by NASA except that distance is added to the list of factors making up the point system. As the work trip distance of carpools increases, more points are awarded to a carpool.
- McDonnell-Douglas (St. Louis) -- During the height of the aerospace boom when McDonnell-Douglas had 47,000 people employed at its facility at Lambert Field, the carpooling program increased average auto occupancy to 2.8 persons per vehicle. As an incentive, preferential parking close to the plant was provided. Presently, with 25,000 employees and smaller demands on the parking areas, average occupancy has declined to about 1.8 persons per automobile.
- In Little Rock, Arkansas -- 500 preferential, close-in parking spaces are provided for carpools at the State government facility. The number of employees using carpools has increased from 400 to 1,100.
- Colorado Ski County, a private, nonprofit organization supported by the ski areas of Colorado, arranges for skiers to meet on weekends at a high school parking lot in Denver, where carpools to the ski areas are formed. On a recent weekend 30 to 40 autos were parked in the lot, which is patrolled by local police.
- The Chicago Transit Authority is attempting to set up a carpooling program for vehicles that park at rapid transit stations in the area. Spaces may be reserved on a priority basis.
- Park-Ride Lots for transit riders are provided in many locations around the country. A notable example is the Blue Streak Project in Seattle. Similar park-ride lots are being implemented for buspool operations. In the Washington, D.C. area, for example, a large suburban employer, GEICO, provides buspool service from three scattered suburban park-ride lots.

Public Information Activities

Public information refers to methods and techniques used for (1) promoting the idea of carpooling, (2) informing potential carpoolers about the availability of carpooling programs, (3) helping participants understand the use of the program.

The most significant local public information activities related to carpooling are being carried out by local radio stations, television stations and newspapers in conjunction with public carpooling programs which they themselves are sponsoring. These activities take the form of radio or television advertising and spot announcements (WBZ Boston, WIND Chicago, KYW Philadelphia, TV5 Atlanta, KFJZ Ft. Worth, KLIF Dallas, KRMG Tulsa), newspaper advertisements and publicity articles (St. Louis Globe-Democrat, New Haven Register), promotional kits containing bumper stickers, decals, and tips on conserving fuel (WBZ, WIND, the St. Louis Post-Dispatch) and slogans (the most common being "Pool It" coined by the Highway Users Federation for Safety and Mobility).

WBZ/ALA Program - Most of the radio-television carpool programs are patterned after one launched in September of 1973 by Radio Station WBZ in Boston with the ALA Auto and Travel Club as cosponsor. This program computer-matches persons in the Boston metropolitan area who fill out and mail a questionnaire on which they indicate their commuter needs and preferences. Each applicant receives as many as 10 names and telephone numbers of others making similar commutes, and it is up to him to contact others to arrange a carpool. Along with his printout, the participant receives a membership card, membership decals for applying to his car windows, a personal accident checklist (with the advice that he consult his insurance agent concerning any questions he may have about carpool coverage) and a "Visor Advisor" displaying maps of major commuter routes and parking facilities in downtown Boston containing 300 or more spaces.

The WBZ program is promoted through public service announcements on both radio and TV, through newspaper advertisements, and by corporations and organizations in the area, such as the Chamber of Commerce. The Mayor of Boston sent a letter to city employees describing the program and urging them to participate. (Form letters from the heads of the sponsoring organizations to potential carpoolers are probably the most common public information techniques used to promote carpool programs.)

Some 7,500 persons had returned questionnaires as of November 30, 1973, and approximately 23 percent of these were "matched" by the computer program. There are no data concerning how many pools were actually formed as a result. One reason for the limited impact of the program may be the absence of any carpooling incentives, according to DOT's Transportation System Center. (3) The main value of this type of promotion is in building positive attitudes about carpooling and informing commuters about ongoing carpool activities that can be beneficial. These functions are vital ones, regardless of the lack of success of KBZ's matching process. Previously, it has been observed that employer based matching efforts are likely to achieve greater success than the regionwide approach.

Operation Oxygen, Inc. - Is a nonprofit volunteer organization, headquartered in Pasadena, which is dedicated to clearing the air on the Los Angeles Basin by reducing the number of cars on the road. They pursue their goals primarily through public information programs and technical assistance efforts.

The Operation Oxygen (4) plan to reduce the number of automobiles in use is the promotion of:

1. Sharing rides by using carpools
2. Utilizing available public transportation
3. Walking or bicycling when possible

The organization's principal concern has been promotion of carpooling. Computer programs and procedural guides have been prepared for use by various types of employers in providing carpool matching services for their employees. Even though it operates on a slim budget, raised entirely from voluntary contributions, Operation Oxygen has been an important force in Southern California as evidenced by the number of organizations that have requested information or assistance. Approximately 500 organizations, including many outside of California, have requested Operation Oxygen information and staff members estimate that perhaps 20 to 25 percent of these are actually planning or operating matching services.

Among the more significant carpooling activities that have been encouraged and assisted by Operation Oxygen are the following:

Aerospace Corporation
Burroughs Corporation

California State University San Bernardino
General Telephone Company
I. T. T. - Gilfillan, Inc.
Kaiser Steel - Fontana
Long Beach Naval Shipyard
Los Angeles County
Los Angeles City
Riverside County
Seven Los Angeles Banks Group
Singer Libracope
Xerox Data Systems

Significant Integrated Carpool Programs

This section describes a selected group of significant carpool activities ongoing around the country. The most successful activities seem to be those which approach the problem with an integrated program composed of a combination of carpool matching, provision of incentives, and effective public information and employee communications programs. Most importantly, the degree of success depends on a firm commitment by top management of a company or other group to pursue a well organized and adequately supported program.

Government Employees Insurance Company - In a Maryland suburb of the Washington, D.C. metropolitan area, the Government Employees Insurance Company (GEICO) responded to a parking shortage crisis with a successful program of carpooling and buspooling. GEICO was expanding its facilities and number of employees, and zoning approval was denied for constructing additional parking spaces due to the serious traffic congestion already existing in the general area. The response was a combined program of carpool matching, priority parking for carpools, and company subsidized buspools. A substantial increase in average vehicle occupancy has resulted from these incentives, 230 carpool parking permits have been issued, 300 employees are riding in eight buspools which provide service from three outlying shopping centers, where fringe parking areas are set aside, to the GEICO office.

McDonnell-Douglas, St. Louis - This large aerospace company has been engaged in successful carpooling activities for more than 20 years at its plant in St. Louis. The program reached its peak of success at the height of the aerospace boom when 47,000 employees worked at the facility and average occupancy was 2.8 persons per car. Currently, the facility has 25,000 employees and occupancy is still comparatively high at 1.8 per car. The success of this program can be attributed to the combined effect of the following elements:

- Carpool matching using locator boards
- Preferential parking in close-in spaces for carpoolers
- Excellent service by a private bus company providing McDonnell-Douglas with 20 premium buses from semi-rural residences 25 to 50 miles distant
- Public transit service by 14 buses which circulate through the facility. Four afternoon buses start their runs at the plant

Connecticut DOT Carpooling Program - Beginning early in 1972, the Connecticut Department of Transportation has been aggressively pursuing a program to encourage carpooling among their employees and among other state employees working in the Capitol complex in Hartford, Connecticut. This program is composed of several elements including computer matching, preferential parking, aggressive employee communication and assistance to the private sector in organizing carpool programs.

A computer program was developed to match people in the same neighborhoods having similar work schedules. Using the results of the matchmaking program, groups of employees living in the same neighborhood area were invited to informal coffee klatches, held during office hours, for the purpose of matching up with each other through face-to-face contact. The groups ranged in size from 10 to 80 persons. It was believed that this group approach to the final step in the matchmaking process was useful in overcoming some of the psychological barriers present when potential carpoolers have to phone or correspond or visit individually with each other to make a compatible match.

During mid-1972 they initiated a campaign to extend the matchmaking service to other State government agencies located in the Capitol Complex. There are 45 separate agencies employing a total of

approximately 3,300 persons. The majority of agencies, especially the larger ones, indicated an interest in joining the program.

In addition to the employee information program designed to encourage carpooling because of the transportation cost reduction benefits and the community benefits (reduced congestion and air pollution), the Connecticut DOT also arranged for reserved parking spaces for carpoolers as an additional direct incentive. A total of 245 reserved spaces in preferred locations in the State Office Building parking lot were designated as carpool spaces. Spaces were numbered and assigned to qualified carpools. The definition of a carpool was four or more persons commuting together three or more days per week. Some of the pool members can be non-state employees as long as at least three are state employees. Security guards make periodic checks of the reserved spaces and unauthorized cars are subject to a \$15.00 fine.

The Connecticut DOT is also encouraging carpooling by private employee groups in Hartford and is offering the computer match-making service to private organizations.

George Washington High School, Denver - This extraordinary volunteer effort is operated nearly full time by a high school mathematics teacher, one of his students, and 10 to 15 part-time student volunteers from the high school. Working with very little money, this group has achieved measurable success in providing carpool matching and promotion services to many companies and organizations, in the Denver area, including:

- Denver Water Board
- Johns Manville
- 5 Area Hospitals
- Metro State and Auraria Colleges
- Council of Christians and Jews
- Honeywell
- A. F. Accounting and Finance Center
- Greater Western Sugar
- D.D.I. and United Bank of Denver
- A.A.A.

The student group developed an efficient operational computer program for carpool matching. They don't just provide the computer program -- they provide what amounts to a complete management service.

- First, they reach top management of each potential participating company to obtain a commitment
- They provide data forms
- They assist in training company personnel in coding and keypunching employee data
- They run the program on the school's Univac 1106 and return match lists to the companies
- They follow up with each company to provide continuing support and matching updates
- They can't provide incentives, but they do encourage the companies to do so as part of their commitment to the program

The group is currently pursuing advancements in the computer matching tools.

Knoxville, Tennessee - Commuter pooling efforts in this city were begun recently (Fall 1973) as a cooperative effort between the University of Tennessee and the Knoxville Transit Authority. It is an excellent example of an attempt by a transit agency to coordinate their service with carpooling. The carpool/buspool program is viewed as a low cost systematic method of locating demand for transportation service. This is used to identify high demand areas which can support excess buspool service and lower demand areas where carpooling is encouraged.

The first survey identified a large residential area 10 miles from downtown as a candidate for premium fare express buspool service, which was successfully implemented. The citywide carpool/buspool matching activity is now underway. A pilot survey of 5,000 employees was conducted in November 1973 to refine the computer matching tool. The program is coordinated through the Mayor's office and various organizations are represented on the Advisory Committee including local businesses, the TVA, and the University. Newspapers, radio and TV stations are promoting the effort.

SPECIAL CONSIDERATIONS IN CARPOOLING

Discussed briefly in the following sections are several special considerations related to successful carpool/buspool programs. Each of these considerations is the subject of a separate report.

Organization for Carpooling

Past successes and failures can be traced to the existence of, or lack of, a sound organizational structure. Previously, carpool promotion has been largely an isolated phenomenon, with most activities being carried on by individual employers for the benefit of their employees. Now, with the need more apparent for increasing the efficiency of transportation by increasing passenger occupancy in autos and buses, effective organizations are called for to lead and coordinate carpool/buspool programs in each urban area. In a separate report, Organization for Carpooling, examples of existing organizational structures are examined which have met with varying degrees of success, and guidelines are given on organizational structure, management, and public and private agency interrelationships.

The vast differences in each community make it difficult to identify all organizations, agencies, or individuals that should be involved in all communities since each agency and organization has a slightly different role in each respective area. Communities which have a very strong, popular Mayor might coordinate the local program through a transit authority or Mayor's office. In other communities the Council of Governments, business, leaders, civic groups or the media may be the most logical choice. In larger cities it may be wise to have area coordinators who are responsible for subareas within each community. Whichever the situation, the organizational structure should be built around existing agencies and preferably, those already interested in transportation affairs. A totally new agency should not be necessary. Ideally the organizational structure should tie in with the existing planning process and transportation system operations.

Legal and Institutional Issues

Various legal and institutional problems can act as significant impediments to carpooling, and these have been explored in depth in a separate report titled Legal and Institutional Issues. Six separate legal issues were investigated: (1) the legality of offering incentives to encourage carpooling; (2) the regulatory status of carpools employing share-the-expense arrangements; (3) applicability of guest statutes to

members of carpools; (4) liability responsibility of sponsors of carpool programs; (5) aspects of competition of carpooling with regulated for-hire motor carriers; and (6) possible applicability of the National Environmental Policy Act.

The potential problems of personal security arising out of widespread carpooling activities are also explored. First, attention is directed toward safeguards necessary in handling the personal information contained on carpool matching questionnaires. Secondly, personal security problems associated with sharing rides with strangers in "casual" carpools is discussed.

Since carpool arrangements may involve financial transactions which could create income subject to federal, state or local taxes, normal tax implications and several outstanding issues which require further clarification are discussed.

The increasing use of carpools raises questions regarding the liabilities of drivers and riders, and the impact of possible changed liabilities on automobile insurance. In most situations the position of an insured driver will not change with the formation of a carpool. There are exceptions, however, and there is a need for review in all cases of the type and amount of coverage required.

Coordination with Transit and Taxi Operations

Carpooling will affect transit and taxi services over the long-term as well as the short-term. The effects can be positive or negative depending on whether transit and taxi operators gear their activities to capitalize on the opportunities generated by the carpooling program. There are a variety of innovative ways for transit, taxi and carpooling to be coordinated to achieve mutual benefits. A separate report, Transit/Taxi Coordination, discusses the potential problems and opportunities and sets forth strategies and guidelines for coordination.

Over the short-term, carpooling must play a primary role in the effort to increase vehicle occupancy for better transportation efficiency. Currently transit and taxi systems do not have adequate peak hour capacity to handle much diversion from commuter automobiles. It is estimated that the typical transit system has about 15 percent unused peak hour capacity. Transit and taxis can benefit in the short-term if extensive carpooling is practiced by serving increased demands for mid-day trips of all kinds for which private autos will be less available.

In the longer run, public transportation has the potential for serving a larger share of the urban travel market. Efforts are needed to ensure that in the evolving transit complex each mode of travel serves its proper role in a coordinated system.

Special Mobility Problems

One report in the series attempts to uncover some of the opportunities existing in carpool action programs to serve the transportation needs of those with special mobility problems. It appears that if conscious efforts are made as part of organized carpool/vanpool/buspool programs to give attention to elderly, handicapped and economically disadvantaged members of the society, then ways can be found to contribute to an alleviation of their transportation problems. Greatest progress can be achieved, in the short term, by employers through: giving top priority to helping the transportation disadvantaged persons employed by the firm; providing company vehicles during the day to volunteer organizations who are helping to serve the transport needs of the community's disadvantaged residents; and making sure that transportation is effectively provided for their own job trainees. Volunteer groups are playing a useful role in helping elderly, handicapped, and low-income citizens with their travel problems, and much more can be achieved if the efforts of these groups are coordinated with those of employers engaged in carpool, vanpool and buspool programs.

Back-Up Systems

What do you do when you miss your carpool? This basic question was the subject of a report in the series, titled Carpool Back-Up Systems, which discusses the common difficulty experienced by carpoolers of finding an alternative means of transport when, for one reason or another, trips need to be made that can't be served by the regular carpool. The report identifies the various types of problems requiring back-up systems and the kinds of solutions which are available already or could be made available by private or public transportation operators. Additional analysis is needed to evaluate the feasibility, cost and relative utility of alternative back-up systems.

AUTOMOBILE OCCUPANCY IN THE UNITED STATES

What is the average automobile occupancy in the United States? Does occupancy vary for different kinds of trip purposes? What other major factors affect the degree of carpooling employed? What is known about the characteristics of persons who have a propensity to use carpools? These are important questions to answer for a basic understanding of carpooling in the United States today. A substantial amount of factual information is available which helps answer these basic questions.

In recent times, the average automobile occupancy has been very low, especially for work trip commutes. The following sections review factual data collected on automobile occupancy, including the factors contributing to lower or higher occupancy.

Work Trip Occupancy

The most comprehensive source of information on automobile occupancy is the Nationwide Personal Transportation Survey. (5) The data in this study were collected during 1969-1970 by the Bureau of the Census for analysis and use by the Federal Highway Administration. This survey shows that the average automobile occupancy for trips to and from work approximates 1.4 persons per car. Interpreted another way, nearly 75 percent of all commuter vehicles have only one occupant -- the driver. During the past month, the Federal Highway Administration has analyzed the occupancy data in greater detail to properly weight the longer, higher occupancy work trips. Their preliminary estimate is that weighted average work trip occupancy for the nation approaches 1.6 persons per car.

The amount of carpooling taking place in some of our major cities is much lower than the national average. A recent study on the Hollywood Freeway (6) in Los Angeles revealed that the average occupancy was only 1.13 persons per car in the morning commuting hours. Nearly 90 percent of these cars carried only a driver.

It is ironic that the commuting trips, which badly strain the capacity of our nation's streets and freeways during peak hours, have the lowest levels of vehicle occupancy. Many transportation experts have viewed this situation with distress for many years. More recently, with growing concern over air quality and other social and environmental issues, a larger number of transportation planners and engineers have been exploring ways and means of increasing ridership in carpools and buses. Their goal was to make more efficient and

productive use of our existing transportation system. The developing energy shortage has vastly increased the alarm over existing low levels of auto occupancy and the belief that ways can be found to alter this wasteful commuter practice through more carpool and bus usage.

Occupancy for Other Trip Purposes

The Nationwide Personal Transportation Study revealed that trips to and from work had the lowest occupancy level. Trips made for any other purpose had higher average occupancies than commuting trips. The occupancies for major categories of trip purpose are shown below:

<u>Trip Purpose</u>	<u>Average Persons Per Car</u>
Work and related business trips	1.4
Family business (shopping, etc.)	2.0
Social, recreational	2.5
School, civic, and religious	2.5

Figure 1 presents a more detailed breakdown of trip purpose and the associated average auto occupancies. The higher occupancy values for non-work purposes raises the national average for all purposes to 1.9 persons per car.

Major Factors Influencing Carpooling

A large number of interrelated factors influence the commuter's decision about carpooling. Included among the major factors are the following:

- Family Income
- Auto Ownership
- Trip Length
- Parking Cost and Availability
- Employment Density
- Employer Size and Type
- Commuter Attitudes

The general effects of these factors on the commuter's propensity to carpool are discussed in the subsequent paragraphs. It must be

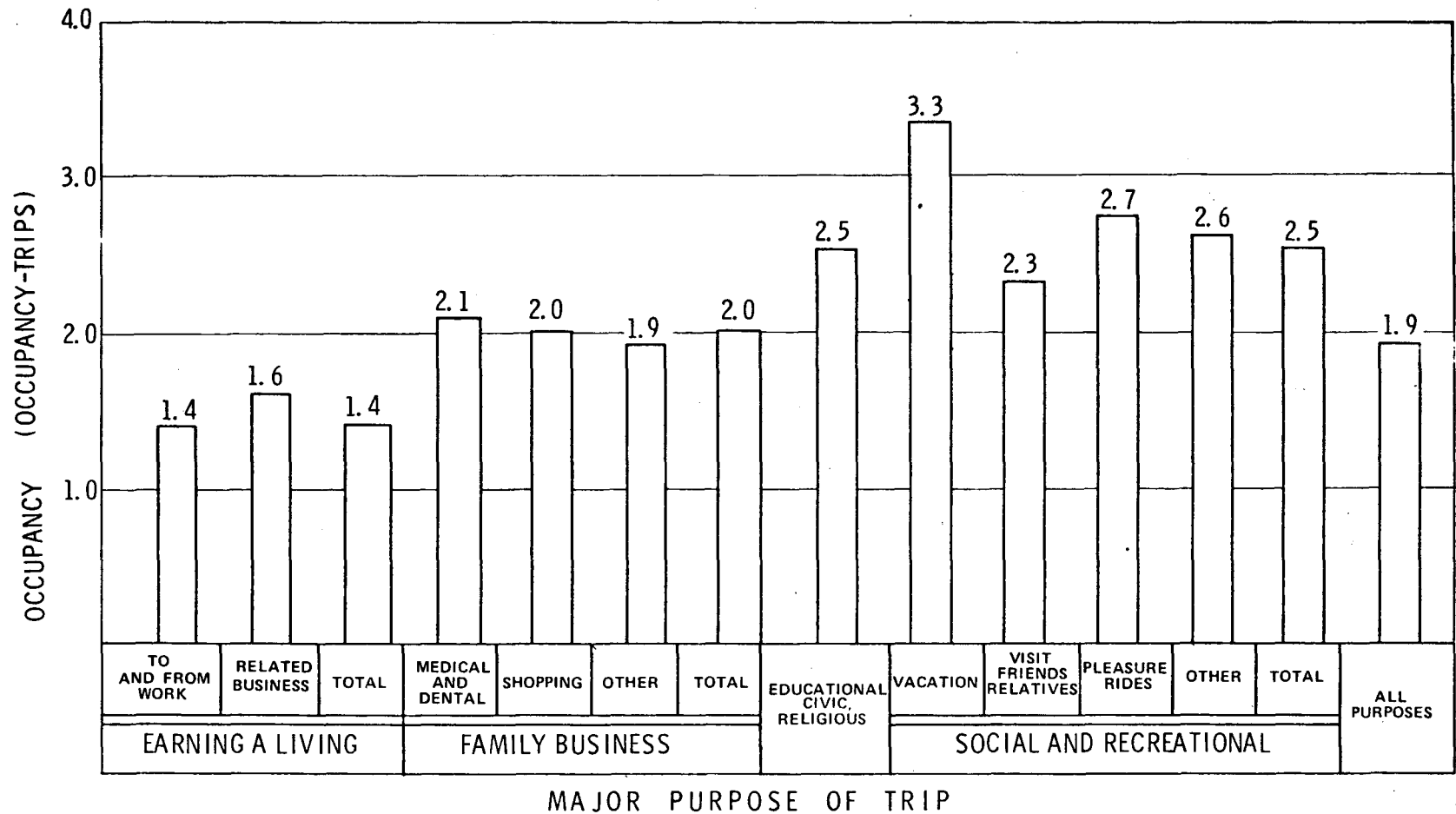


FIGURE 1. AVERAGE AUTOMOBILE OCCUPANCY CLASSIFIED BY PURPOSE OF TRIP

Source: Strate, H. E., Nationwide Personal Transportation Study, Automobile Occupancy, Report No. 1, U.S. Department of Transportation, Federal Highway Administration, April 1972.

remembered that these data on which the following discussions are based was collected when fuel was plentiful and relatively inexpensive. The current situation of scarcity of fuel, rising prices, and/or gasoline rationing will impact strongly on the relative importance of some of these factors as they relate to carpooling in the future.

Family Income -- Many transportation planners have found that family income is a major determinant in choosing between private auto and public transit. Similarly, low income families, by necessity, are more likely to use carpools than higher income families. A good example is the Twin Cities statistical analysis (7) of work trip auto occupancy which showed sharp reductions in occupancy with increasing family income.

Continued rising prices in a free market environment can create a very real hardship for lower income families. They may find virtually no choice but to shift out of the automobile completely and into public transportation and carpools.

Auto Ownership -- Automobile ownership is closely correlated with family income. Logically, families with fewer cars per family member make more frequent use of carpools to meet all kinds of essential travel requirements. (They also make more use of public transit when service is available.) This fact is clearly indicated in the FHWA study (8) which reports higher levels of auto occupancy among lower income groups in several cities. If scarcity of fuel continues and becomes more acute, or prices rise to higher levels, families with multiple automobile ownership will have to reevaluate the relative merits of carpooling versus the practical aspects of indulging in lone driving. The scales would seem to tip in favor of carpooling. There already exists some small movement back to being a one-car family.

Trip Length -- Review of previous studies reveals a mixture of findings with regard to the impact of trip length on auto occupancy. The most authoritative Nationwide Personal Transportation Study does show that longer trips are associated with higher auto occupancy levels. This holds true both for work trips and all trip purposes combined, as shown in Table 1.

A study by Connecticut Department of Transportation (9) supports the Federal DOT findings. This study also determined, however, that for certain types of low occupancy commuting trips -- for example, to jobs in schools and hospitals -- the car occupancy levels are not very sensitive to trip length. Another finding is that for very long

TABLE 1. AVERAGE AUTOMOBILE OCCUPANCY
BY TRIP PURPOSE AND TRIP LENGTH

<u>One-way Trip Length</u>	<u>Trip Purpose</u>	
	<u>Home-to-Work</u>	<u>All Purposes</u>
<u>Miles</u>	<u>Occupancy</u>	
Less than 1/2	1.3	1.8
1 - 2	1.4	1.9
3 - 4	1.3	1.9
5 - 15	1.4	1.9
16 - 20	1.5	1.9
21 - 30	1.7	2.1
31 - 40	1.5	2.3
41 & Over	1.6	2.6
Average	1.4	1.9

Source: Strate, H. E., Nationwide Personal Transportation Survey Automobile Occupancy, Report No. 1, U. S. Department of Transportation, Federal Highway Administration, April 1972.

commuting trips by certain types of employees, such as those working for manufacturing companies and for retailers, the average occupancy is actually lower than it is for medium length trips. This is apparently caused by the added difficulty of finding compatible carpool partners by those living in the outermost fringes of the urban region. With severe fuel shortages and higher cost, the incentive for long distance commuters to carpool will be very strong. Special assistance in finding suitable carpool partners will be especially important for these commuters.

Parking Cost and Availability -- The factor which perhaps has the greatest influence on the degree to which carpooling is practiced is the availability and cost of parking near the place of work. Where parking is scarce and costly, many commuters use carpools, buses, and other forms of public transit. Conversely, in employment locations where parking is plentiful and cheap, such as in many suburban places of work, many commuters drive to work alone. In Los Angeles and similar cities, where employees' direct parking cost is notoriously low and parking spaces are readily available, average auto occupancy levels are very low.

In cities like Washington, D. C. and New York, where parking rates are high and spaces are hard to come by, auto occupancy levels are high. In the National Aeronautics and Space Administration Office Building in Washington, D. C., the extreme scarcity of on-site parking space and the high cost of adjacent commercial parking has spawned a successful carpool management activity which has been in operation since 1964. Current average occupancy at this facility approximates 3.85 persons per car.

More scientific evidence of the cause and effect relationship between parking cost and carpooling is found in many metropolitan area transportation planning studies. A good example is the Washington, D. C. mode choice study (10) which shows that all income groups -- high, middle and low income -- react in the same way to increases in parking cost by joining carpools and riding buses.

High parking cost is a strong incentive to encourage carpooling, even though it is negative in nature. Commuters carpool to avoid a direct cost to them. This factor also impacts more heavily on the lower income commuter whose discretionary income is less. For them, carpooling can be a forced situation rather than voluntary. However, parking availability and convenience are positive incentives. The assignation of reserved or preferential parking is a reward and probably has a stronger appeal for high income groups than low income groups.

Employment Density -- A factor which is rather strongly correlated with parking cost and supply is the employment density, or concentration of workers in a given area, as expressed, for example, in persons per acre. The highest density places are the central business district and, in some larger urban areas, other outlying high activity business centers. These places usually have the highest work-trip auto occupancies. Pertinent comparisons are found in the Twin Cities study (7) discussed previously. For example, medium income commuters traveled to moderate density work locations in autos averaging 1.2 occupants; whereas, similar medium income commuters working in high density places traveled there in cars averaging 1.9 occupants. This clearly indicates that high priority should be given to high density locations. Furthermore, it appears that far greater returns can be expected in work-based matching, since higher densities are normally found in employment centers compared with residential areas.

Employer Size -- Both the Connecticut DOT and the Los Angeles studies revealed a relationship between the size of the place of employment and the propensity to carpool. The average work trip occupancy tends to rise markedly as the number of employees working in one place increases. Carpools are easier to form in larger companies where opportunities are greater to match up with conveniently located partners. In essence, this means that carpools will increase when the number of potential matches are increased. This points up the importance of combining the data bases for neighboring groups of small and medium size groups of employees. This should not necessarily be done based on a rigid geographic guideline but should consider factors such as whether or not the neighboring employee groups might have a high or low degree of social compatibility.

Characteristics of Carpoolers, Potential Carpoolers and Non-Poolers

One objective of the Los Angeles study was to identify discernible differences, if any, in the travel, demographic, and employment characteristics of existing carpoolers, potential carpoolers (commuters expressing an interest in carpooling), and hard core non-poolers (no desire at all to carpool).

Following are generalizations of the common characteristics exhibited by existing and potential carpoolers. These two groups were found to be highly similar in both characteristics and attitudes.

- Carpoolers tend to work in larger groups, although they are found in all group sizes

- Carpoolers tend to work in the higher density activity centers
- Carpoolers tend to pay more for parking than non-poolers
- Carpoolers tend to have slightly lower average family incomes than non-poolers
- Carpoolers tend to have somewhat less flexibility in their working hours, but this is frequently overemphasized
- Carpoolers tend to have lower family auto ownership ratios (i. e. , fewer cars per family member)
- Carpoolers tend to travel slightly longer commuting distances, but this differentiation is another one which is frequently overemphasized
- Carpoolers tend to be slightly younger people than non-poolers

Significant differences were found between the group of potential carpoolers and the group of hard core non-poolers.

- The potential carpoolers tend to enjoy driving with others while the hard core non-poolers have a fairly strong desire to drive alone
- Potential carpoolers tend to feel carpooling will save them money, whereas hard core non-poolers feel any savings are probably not worth the effort
- Independence needs are much stronger among hard core non-poolers. Although both groups tend to dislike relying on others, the hard core non-poolers are much more extreme in this attitude
- Potential carpoolers tend to not mind having people depend on them, but hard core non-poolers strike a neutral stance on this question
- Both groups are relatively neutral in their civic obligation to help others, although carpoolers tend to feel slightly more positively
- Both groups agree that rush hour is irritating, that carpooling would help reduce air pollution and traffic congestion. However, the potential carpoolers are significantly stronger in these beliefs than hard core non-poolers

A note of caution. The survey data summarized above were collected in the summer of 1972 when gasoline prices were a lot lower than today and before any prominent mention of the emerging fuel shortage.

In light of the vast difference in conditions then and now, general attitudes towards carpooling have undergone noticeable change. Greater numbers of people seem to be more receptive to the idea of carpooling, including some former hard core non-poolers. Their attitudes may not have changed dramatically, but their motivation to consider carpooling certainly has changed. Rationalizations and psychological needs which were viewed as deterrents to carpooling are being re-evaluated and different priorities are being established by individuals who wish to function without severe disruptions during the fuel shortage.

Consideration of these differences in attitudes should be given for both the marketing efforts and adoption of the carpool program to make carpooling more appealing and the transition from low occupancy cars easier.

Reasons for Not Pooling

In the Los Angeles study, many reasons were cited for not carpooling. The two most frequently given reasons -- working hour variance, and need for car during the day -- are believed, in part, to be more excuses than real problems. In fact, the study showed that those who do carpool actually have as much need to use a car during business hours as do the non-poolers. A little planning on the part of the carpool partners allows them to overcome many problem situations involving vehicle needs during the day. Schedule variance, while certainly a major problem for some lone commuters with demanding jobs, could undoubtedly be resolved for some with simple changes in personal work habits, given the proper motivation.

Neither of these reasons reflects the underlying psychological attitudes uncovered in the study. It was found that strong independence needs exist. Hard core non-poolers want the freedom to come and go at their own convenience. They do not want to depend on others or have others depend on them, especially if it interferes with their freedom. This factor may indeed be the biggest barrier to overcome in achieving increased carpooling. Like the tip of the proverbial iceberg, these needs suggest a stronger psychological and attitudinal resistance than is apparent on the surface.

It bears repeating that these findings predate the energy crisis. Given a real pinch on gasoline, whether arising through free market or regulatory forces, many of the subtle factors previously influencing propensity to carpool may fade into insignificance. Ways will easily be found to set aside the superficial reasons for not pooling and, in fact, many of the real barriers to higher occupancies will, out of necessity, be overcome by individuals. A well conceived National Carpooling Action Program can help smooth the way for this problem solving process.

CONCLUSIONS

This report has attempted to provide an overview of the current state-of-the-art of carpooling in the United States by discussing automobile occupancy, the primary elements of carpool activities, and existing carpool activities. Overall automobile occupancies, which provide a measure of the extent of carpooling or ride sharing, are low in the U. S. Work trips in particular have the lowest automobile occupancies of any trip purpose. Although estimates vary depending on the numerical averaging technique, average automobile occupancy for work trips in the U. S. is approximately 1.4 to 1.6 persons per vehicle. Based on the national averages, nearly three-quarters of commuter cars are occupied by only one person.

There are a number of factors that tend to be correlated with automobile occupancy and therefore with the extent of carpooling. These include income, automobile ownership, trip length, parking cost, employment density, and employer size and type. In general, carpooling is most common in high-density employment areas with high parking costs. As incomes and the level of automobile ownership increase, the extent of carpooling tends to decrease; however, if rationing is instituted, and depending on the exact mechanism used, this relationship may no longer hold. In addition, carpooling tends to increase as the length of work trip increases above 15 miles.

Based on the review of existing carpool activities throughout the country, a general profile can be constructed as follows:

- Although many types of institutions are involved in carpooling, including some regionwide programs, the overwhelming majority of existing carpool programs are employer-based, employer-originated, and employer-sponsored. We believe that over the next six months the employer-sponsored activities will continue to be most vital.

- With the exception of carpool programs to ski areas and special event buspools, carpooling programs are focused on the work trip.
- A number of operational computer programs are available to assist in carpool matching; however, the preponderance of existing carpooling efforts use manual matching methods or simple computer sorting programs.
- When a special carpooling incentive is provided, it most commonly takes some form of preferential parking. In high-density employment areas, parking cost subsidies are sometimes provided to carpoolers by employers as well. In an energy crunch, such incentives will be less powerful than fuel shortages.
- With the exception of major traffic and highway improvements aimed at preferential treatment for buses and carpools, most carpool incentives are provided by the employer. Thus there is a logical tie between the ability to provide special incentives and the level at which carpools are organized.
- One of the most exciting and promising of the recent carpool programs deserving special attention is 3M's Vanpool Program. It uses a unique combination of incentives to the van driver/coordinator and the rider. The 3M program has created a demand for vanpools that presently exceeds supply. Significantly, this program is proving to be successful in a predominately suburban area.
- As the next few months progress, the proper role of all levels of government will evolve through a reasoned process of planning, testing, and monitoring, various kinds of carpool action programs.

Based on an examination of the carpooling programs that are exhibiting some signs of success, a number of ingredients to a successful program have been identified. These include:

- The commitment and active support of top management in employer-based programs and of top public officials in regionwide programs
- The maximum involvement of the members of the potential user group so that it becomes "their program"

- The provision of tangible special incentives for carpools, such as parking charges preferred parking, or the use of company-owned vehicles
- A commitment to a continuing program with periodic updates instead of a "one-shot" program
- The development of procedures to encourage positive feedback to employee carpoolers in the form of newsletters, display posters, mass media publicity, etc. along with continuous program monitoring
- The use of proven and uncomplicated matching techniques to which potential carpoolers can relate
- A sufficient amount of promotion and program information to insure that potential carpoolers are aware of the program, its advantages, and how to use it.

While attention to these essential ingredients will not guarantee success in every carpooling program, experience indicates that the chance of success without such attention is remote. The fuel shortage has created a situation in which a successful short-range nationwide carpooling program is crucial. For the long run, however, the opportunity has been provided for careful planning of the proper role of carpooling, buspooling, and related travel demand management methods in the nation's overall transportation system.

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