

Who Switches to Alternative Work Hours and Why

ALFRED J. NEVEU AND K.-W. PETER KOEPEL

A survey of employees at the main office of the New York State Department of Transportation was undertaken in late May 1979 to determine their response to a program of alternative work hours implemented in December 1978. The survey contained questions that dealt with changes in work schedules, perceived impacts, characteristics of work trips, and demographic information. A sample of 105 employees was obtained, and the sample provided a good representation of the total work force of the main office. Examination of the responses yielded the following results: More than half of the employees surveyed changed their work schedule; the majority switched to earlier starting times. Respondents who have long commute times were more apt to shift; however, even nonswitchers also saved travel times. Thus, this program reduced highway congestion somewhat. Contrary to expectations, ridesharing increased after implementation. The primary reason for this was the department's Carpool Coordinator Demonstration Project. Attitudes toward travel impacts generally do not influence the desire to alter work schedules. On the contrary, alteration of one's work times leads to favorable attitudes toward travel-related impacts of alternative work schedules.

The concept of alternative work hours has been under discussion for many years; proposals range from staggered work hours to compressed workweeks. Tannir (1) provides a comprehensive review of the work in this area. Alternative work schedules have been implemented by various government agencies and business enterprises in the United States and overseas, particularly in Germany (2). Proponents of the strategies claim increased employee morale, productivity, and job satisfaction as the primary benefits of such programs.

In view of the current energy situation in the United States, renewed interest has been focused on alternative work schedules by government planners and members of the business community as a way of promoting energy conservation in work travel by reducing highway congestion. Accompanying this resurgence of interest comes the need to better understand the impacts of such strategies, both positive and negative, and the demographic, travel, and attitudinal characteristics of the employees who elect to alter their work schedules. The main thrust of this report is to provide some information on the latter two issues.

Table 1. Representativeness of sample.

Item	Sample (%) (n = 105)	Main Office (%) (n = 1735)
Grade and salary		
1-9, \$6 500-\$9 800	27.6	30.6
10-19, \$10 400-\$17 300	35.2	37.7
20-29, \$18 200-\$29 300	36.2	26.6
30+, \$30 800 +	1.0	5.1
Bargaining unit		
Administrative	28.6	28.8
Operational	1.9	1.8
Institutional	0.0	0.1
Professional, scientific, and technical	61.9	55.8
Management, confidential	7.6	13.5

Table 2. Changes in work schedules.

Time Period	Percentage of Respondents Working				
	7:00 a.m.- 3:10 p.m.	7:30 a.m.- 3:40 p.m.	8:00 a.m.- 4:10 p.m.	8:30 a.m.- 4:40 p.m.	9:00 a.m.- 5:10 p.m.
Before December 1978	0	0	100	0	0
December-March 1979	6	26	56	9	3
April-June 1979	17	28	49	6	0

In 1977, the Planning Research Unit of the New York State Department of Transportation (NYSDOT) conducted a study of employee favorability toward alternative work schedules (3) to determine what factors influence attitudes and willingness to participate. Surveys were conducted in the main office in Albany, New York. Results showed that the primary motivation behind favorability was the desire for flexibility in family life; alternative work hours were most favored by employees younger than 45 who were from three- or four-person families and professionals. Attitudes were generally favorable and highest for leisure and family activities.

In December 1978, NYSDOT implemented a program of alternative work hours for employees in its main office. Under this arrangement, employees may elect to alter the former work schedule (8:00 a.m.-4:10 p.m.) to one of five alternative schedules, which includes the former one. The employees work those schedules for one calendar quarter, at which time they have the option of selecting a different schedule or remaining with their previous selection.

In late May 1979, the Planning Research Unit of NYSDOT undertook a simple random survey of employees of the main office to determine their response to the implemented program of alternative work hours. The survey contained questions on work-schedule changes, perceived impacts, characteristics of the work trip, and demographic information. A sample of 105 responses was obtained; the respondents provided a good representative sample of the total work force at the main office on the characteristics of state grade level and bargaining unit (Table 1). A companion paper (4) analyzes a special portion of these data collected in the trade-off format. A more detailed discussion of the survey methodology may be found elsewhere (5).

The analysis focused on three areas:

1. What were the work-schedule changes adopted by the employees? How many workers altered their schedules?
2. What were the effects of the alteration of work hours on the trip to work, including travel times and mode changes? and
3. What were the characteristics of the individuals who opted to change their work schedules?

WORK-SCHEDULE CHANGES

Table 2 shows a percentage breakdown of the changes in work schedules for each of two quarters. It can be seen that 44 percent of the sample opted to alter their work schedules in the first quarter after implementation; this number increased to 51 percent in the second quarter. This second-quarter number includes new work-schedule changes from the 8:00

Table 3. Characteristics of those who shifted work schedules.

Characteristic	Percentage Who Changed Work Times	Characteristic	Percentage Who Changed Work Times
Sex		Carpool	
Male	61	Yes	49
Female	35	No	58
Age		Mode to work	
19-34	64	Car	54
35-54	53	Bus	34
55+	42	Other	88
Cars per household		Travel time (min)	
0	0	0-15	61
1	20	16-30	68
2+	35	30+	45
Household size		Travel distance (miles)	
1-2	53	0-15	51
3-4	53	16-30	56
5+	63	30+	65
State grade		Bargaining unit	
1-9	40	Administration	41
10-19	57	Professional, scientific, and technical	62
20+	63	Management, confidential	50
Traffic congestion			
Low	49		
High	62		

shifted their work schedules at any time is 54 percent.

A vast majority of those respondents who altered their work schedules selected earlier starting times (77 percent), especially in the second quarter. One possible explanation for this behavior would be the desire for earlier work hours during the summer months (a resurvey in the winter months would confirm or dismiss this assumption).

TRAVEL TO WORK

The table below shows automobile and public transit (bus) use for the work trip both before the implementation of the alternative-work-schedule program and currently.

Mode	Percentage Using Mode	
	Before December 1978 (n = 105)	May 1979 (n = 105)
Car	83	85
Public transit	7	6
Other	10	9

The automobile is by far the predominant mode of travel for the work trip in both time periods. The location of the main office is well served by several arterials and expressways, has plenty of free parking for employees, and is poorly served by the local bus system. Thus, this high automobile use comes as no surprise.

One of the most often cited negative impacts of

a.m.-4:10 p.m. time period as well as those employees who altered their work schedules for a second time. The total percentage of employees who

Figure 1. AID tree.

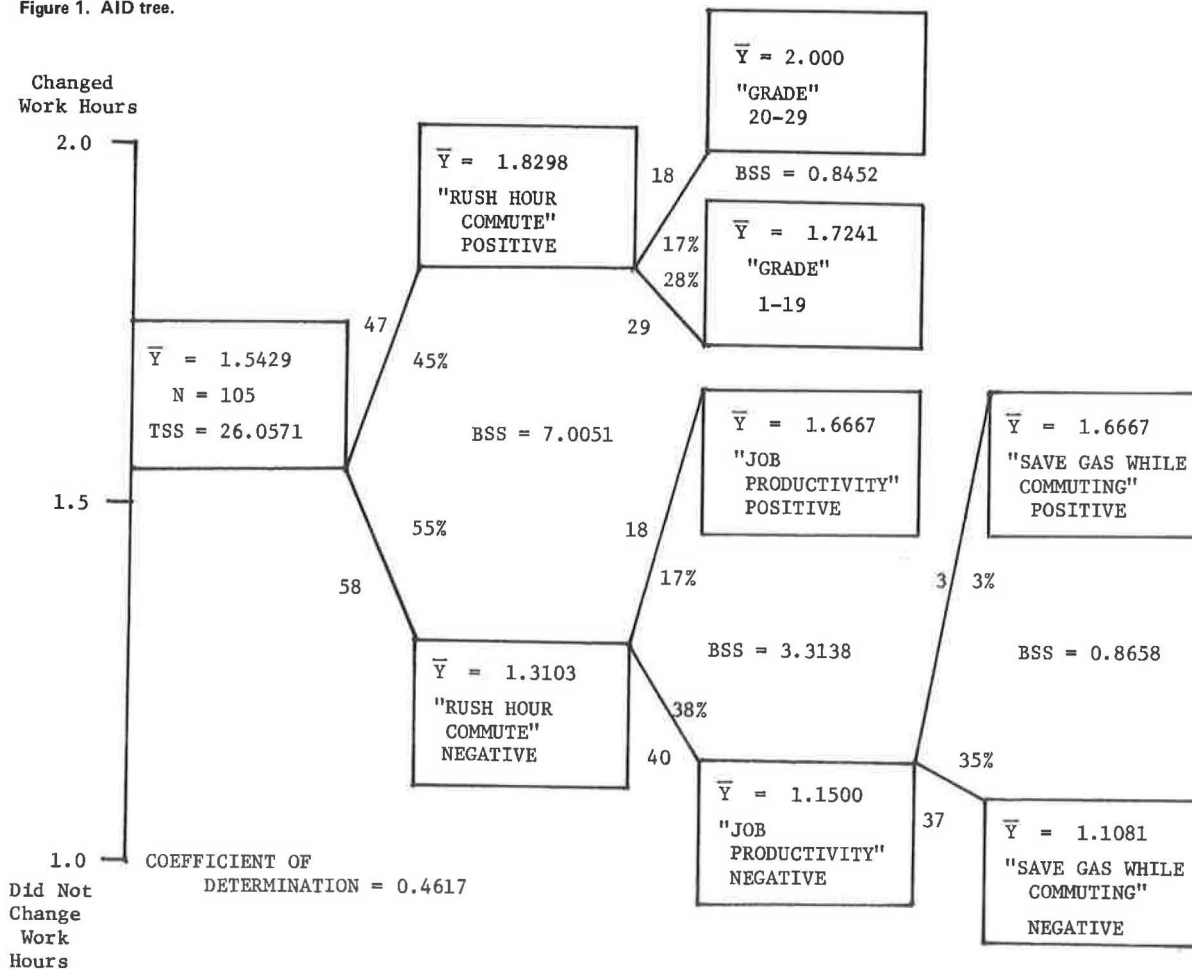
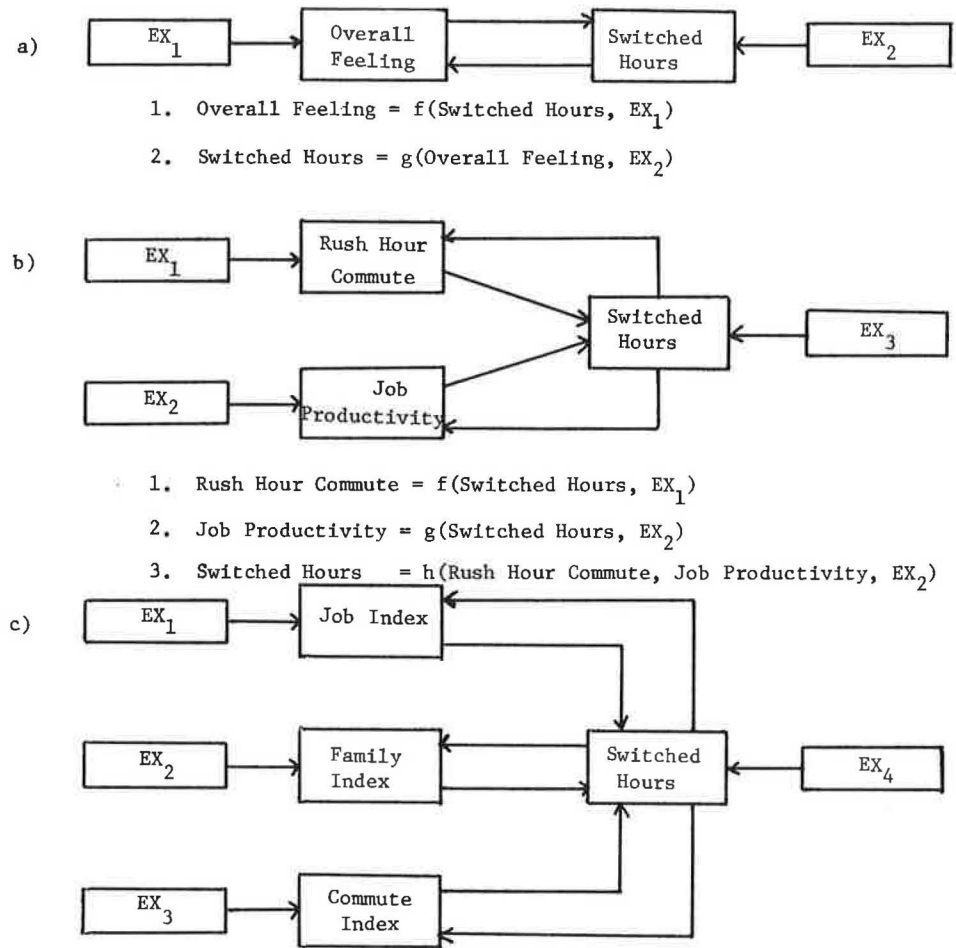


Figure 2. Paradigm of two-stage least-square tests.



- 1. Job Index = f (Switched Hours, EX_1)
- 2. Family Index = g (Switched Hours, EX_2)
- 3. Commute Index = h (Switched Hours, EX_3)
- 4. Switched Hours = j (Job Index, Family Index, Commute Index, EX_4)

where

Job Index = average attitude score for Opportunity for Second Job + Job Satisfaction + Job Productivity + Communication with Employees and Public + Fatigue;

Family Index = average attitude score for Leisure Time + Family Time + Use of Vacation Time + Use of Sick Leave + Use of Personal Leave + Ability to Do Shopping and Errands + Child-Care Arrangements; and

Commute Index = average attitude score for Rush-Hour Commute + Save Gasoline While Commuting + Ability to Form Carpools.

alternative work schedules is the decreased ability to form and maintain carpools. In an effort to determine the impact of the new work-schedule arrangements, the respondents were queried as to their ridesharing behavior both prior to implementation and currently. Those results are summarized in the table below.

Response	Percentage Who Rideshare	
	Before December 1978 (n = 105)	May 1979 (n = 105)
Yes	27.6	30.5
Sometimes	6.7	10.5
No	58.1	52.4
Car not used	7.6	6.6

From that table, it can be seen that, contrary to expectations, ridesharing behavior actually increased (from 34.3 percent to 41.0 percent) after the program of alternative work hours was established. However, during this same time period (January-June 1979), the department's Carpool Coordinator Demonstration Program (6) was also in operation and, of course, energy prices rose rapidly and gasoline shortfalls appeared. It is reasonable to assume that a large portion of the increase in carpooling is attributable to these other events. Whatever the reason, it is therefore possible to alleviate, or even reverse, the trend away from carpooling after the implementation of an alternative-work-schedule program, thus removing one

of the prime detriments to the increased use of such programs.

The table below shows the average travel times (one way) before and after implementation for respondents who changed their work schedule and those who remained on the old schedule.

Response	Average Travel Time to Work (min)		Average Savings (min)
	Before	After	
	December 1978	May 1979	
Changed work hours	34.7	28.1	6.6
Did not change	28.4	27.3	1.1
Avg	31.8	27.7	4.1

Overall, the average savings per respondent was more than 4 min each way or more than 8 min/day. This is almost a 13 percent saving in travel time for the entire sample. Those respondents who changed their work schedules saved 19 percent of their previous travel time by changing their schedules. Moreover, the respondents who did not change their work schedules saved 4 percent, which implies reduced congestion for nonswitchers. Thus, savings in travel time for the work trip accrue to all employees in an alternative-work-schedule environment. The largest savings, however, go to those employees who alter their work schedules since, on the average, they had a longer work trip than employees who did not change their work schedule. This result confirms theoretical work published earlier (7).

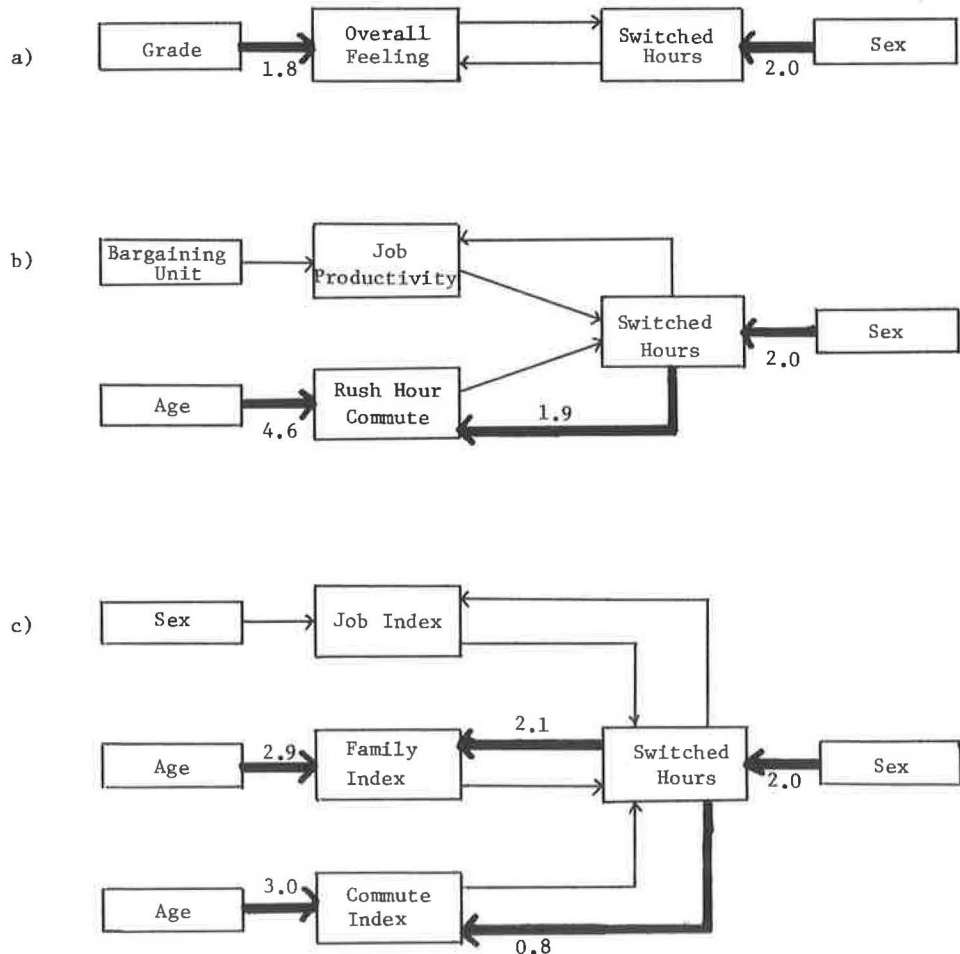
CHARACTERISTICS OF SHIFTERS

The analysis in this phase of the research was performed in two parts. First, by using only demographic information collected in the survey, descriptions of the types of employees who altered their work schedules were developed. Second, the demographic information was combined with attitudinal information on the perceived impacts of the alternative-work-hours program in order to judge the effect of attitudes toward travel impacts on the propensity to alter work schedules.

In the second phase of this analysis, a statistical tool called Automatic Interaction Detector (AID) was used. The objective of AID is to explain the variance of the dependent variable, in this case, whether the respondent altered his or her work schedule. The algorithm divides the sample on a series of binary splits by using the independent variables. The independent variables are selected in decreasing order of their power to explain the variance on the dependent variables. AID has been used in several studies at NYSDOT (1,8,9) and a more detailed discussion of this procedure may be found elsewhere (10).

Table 3 shows results from the first phase of the analysis, by using the demographic data to describe the respondents who changed their work schedules. Several conclusions are readily evident when considering this table. First, men had a greater propensity to change their work schedules than did women; younger employees, those from larger households, those who thought traffic congestion on the work trip before implementation was bad, and

Figure 3. Results of two-stage least squares.



those at higher state grade levels (higher income levels) were also more apt to switch hours. Employees who did not change their work schedules may be characterized by the following: women, older employees, from smaller households, make shorter work trips, and lower state grade levels.

These results are similar to those predicted by Tannir (1) by using the trade-off method. He analyzed the favorability of several programs of alternative work hours at NYSDOT and estimated their acceptability to the employees. The results from this research confirm his estimates.

To determine the influence of the respondent's attitudes toward the impacts of this program, several AID runs were conducted by using the demographics and perceived impacts as the dependent variables. Figure 1 presents the run that explains the greatest variation of the dependent variable (changes in work hours).

The AID tree demonstrates the importance of the perceived impacts of the alternative-work-hours program. Those employees who perceived negative impacts in "having to commute during rush hour," "job productivity," and "saving gasoline while commuting" were less likely to change their work schedules. Those who had a favorable attitude toward "rush-hour commuting" and were in the high state-grade-level positions were the most likely group to change their work schedules. This AID tree explains 46 percent of the variation in the sample.

The first split in rush-hour commuting is similar to what was seen by Tannir (1). In his work, when the independent variable was "overall attitude toward variable working hours," the first split was identical.

However, it is unclear whether the perception of the positive effect on commuting during rush hour caused the switching behavior or whether the switching behavior caused the positive perceptions. In order to test the interrelationship between attitude and behavior, three hypothesized relationships of attitudes and behavior were tested by using two-stage least squares. This technique has been applied in previous tests of attitude and behavior linkages (11-13) and has been found to be a useful tool.

The three paradigms are illustrated in Figure 2 along with the equations (and the definition of the variables) derived from each hypothesis. The results are shown in Figure 3.

For the first paradigm, there was no significant relationship between overall feeling toward the program and changing work hours. In the second paradigm, there is only a one-way relationship between the impact of rush-hour commuting and whether the respondent altered his or her work schedule. This relationship implies that the favorable attitude toward rush-hour commuting was formed after the change in the respondent's work schedule, and some positive aspects of the commute to work under alternative work schedules was experienced.

In the third paradigm, again the attitudes had no influence on changing work schedules, but the change in work schedules influenced, albeit weakly, the feelings toward family activities and commuting. This result adds support to that obtained from the second paradigm. The above analysis can be summarized as follows: Travel habits and attitudes do not influence the propensity to alter work schedules, but the alteration of those schedules produces favorable attitudes toward the travel impacts and family-related alternative-work-schedule programs.

SUMMARY AND CONCLUSIONS

A survey undertaken after the implementation of a program of alternative work hours queried the employees on their work-hour shift, work travel habits and changes, perceived impacts of the program, and demographic data. The analysis examined the magnitude of the changes in work schedules, the changes in work travel patterns, the characteristics of the respondents who shifted their schedules, and the influence of travel habits and attitudes on the potential to change work hours. From these analyses, the following conclusions are evident:

1. More than one-half of the employees surveyed changed their work schedules; the majority switched to earlier starting hours.
2. Respondents who have long commute times were more apt to shift and saved 20 percent of their travel time; however, since even nonswitchers also saved travel time, this program reduced highway congestion somewhat.
3. Contrary to expectations, ridesharing increased after implementation, the primary reason being NYSDOT's Carpool Coordinator Demonstration Project. Thus, one of the major negative impacts of alternative work schedules--reduced carpooling--can be alleviated with the addition of ridesharing incentives.
4. Employees who shifted work schedules can be characterized as male, younger, from larger households, thinking that traffic congestion before implementation was bad, and in the higher state grade levels (higher income levels).
5. Attitudes toward travel impacts generally do not influence the desire to alter work schedules; on the contrary, alteration of one's work times leads to favorable attitudes toward travel-related impacts of alternative work schedules.

Overall, it is evident that NYSDOT's program of alternative work hours has a favorable impact on the employees and their commuting to work. More research is needed in order to further quantify the impacts of such programs. In this time of concern with energy conservation and the search for effective and efficient policy actions, the implications of programs of alternative work hours must be given due consideration as a feasible option.

ACKNOWLEDGMENT

We want to take this opportunity to express our gratitude to those individuals who provided invaluable assistance in the course of this project: Stephen P. Daly for his assistance in the initial phases of the project, David T. Hartgen for the many valuable comments and suggestions he provided throughout the entire research effort, and, last, very special thanks to Diane E. Davis and Wilma C. Marhafer for their excellent typing of the questionnaire and report under tight deadlines. We, of course, are responsible for any errors of fact or omission.

REFERENCES

1. A. A. Tannir. The Impacts of Feasible Staggered Work Hours and Compressed Workweek Policies on Highway Networks, Transportation Economics, Organizations, and Employees. Planning Research Unit, New York State Department of Transportation, Albany, Prelim. Res. Rept. 129, 1977.

2. R. K. Herz. Traffic Impacts of Work Schedule Changes--A Redistribution Model. Paper presented at the Annual Summer Meeting, Planning and Transport Research and Computation, Inc., England, 1975.
3. A. A. Tannir and D. T. Hartgen. Who Favors Work-Schedule Changes and Why. TRB, Transportation Research Record 677, 1978, pp. 53-58.
4. K.-W. P. Koepfel and A. J. Neveu. Acid Test of the Trade-Off Method of Attitude Measurement. TRB, Transportation Research Record 765 (in preparation).
5. A. J. Neveu and K.-W. P. Koepfel. Who Switches to Alternative Work Hours and Why. Planning Research Unit, New York State Department of Transportation, Albany, Prelim. Res. Rept. 162, 1979.
6. J. M. Brunso and D. T. Hartgen. Carpool Coordinator Demonstration Study: Overview and Analysis of "Before" Survey Data. Planning Research Unit, New York State Department of Transportation, Albany, Prelim. Res. Rept. 150, 1979.
7. A. A. Tannir and D. T. Hartgen. Traffic Impacts of Work-Schedule Changes in Medium-Sized Urban Areas. TRB, Transportation Research Record 677, 1978, pp. 58-61.
8. D. P. Ballou, D. T. Hartgen, and L. Mohan. Distance-Based Transit Fares: Robin Hood or Sheriff of Nottingham? Planning Research Unit, New York State Department of Transportation, Albany, Prelim. Res. Rept. 145, 1978.
9. C. E. Meyers. Factors Affecting Willingness to Conserve Gasoline. TRB, Transportation Research Record 751, 1980, pp. 27-30.
10. J. A. Sanquist and J. N. Morgan. The Detection of Interaction Effects. Survey Research Center, Univ. of Michigan, Ann Arbor, 1964.
11. R. Dobson and others. Structural Models for the Analysis of Traveler Attitude-Behavior Relationships. Transportation, Vol. 7, Nov. 4, 1978.
12. T. J. Tardiff. Causal Inferences Involving Transportation Attitudes and Behavior. Transportation Research, Vol. 11, 1976.
13. J. M. Brunso, M. A. Kocis, and W. R. Ugolik. Factors Affecting Ridesharing Behavior. Planning Research Unit, New York State Department of Transportation, Albany, Prelim. Res. Rept. 165, 1979.

Publication of this paper sponsored by Committee on Traveler Behavior and Values.

Microsimulation of Organized Car Sharing: Description of the Models and Their Calibration

PETER BONSALL

This report is one of a series that report the methodology and findings of an investigation of the likely impact of organized car-sharing schemes. This volume summarizes the structure of a microsimulation model of organized car sharing. It includes a description of the model itself, the preparation of the necessary data base, and the calibration of the choice models by using data from a special survey. Microsimulation is a technique of computerized modeling within which the decision-making process is replicated for each individual in the system. Monte Carlo sampling of probability distributions is used to generate all the individual decision makers, each of whom is uniquely identified within the model. The model consists of three stages: In the first stage it considers each eligible trip maker and predicts whether or not he or she will apply to join an organized car-sharing scheme; in the second stage all these applications are processed to produce match lists of potential traveling companions; in the final stage the model considers the decision by each applicant of whether to form a car-sharing arrangement with anyone on his or her match lists. The model was successfully calibrated and its predictions accord well with empirical evidence of the performance of car-sharing schemes.

This report is one of a series (1-3) that emanates from a study of organized car sharing. Readers interested primarily in the likely effects of car-sharing schemes will find the relevant results of the modeling exercise elsewhere (3); those who have an interest in the surveys on which calibration of the models is based should see another report (2).

The objective of the study was to provide guidance for policymakers who are contemplating the implementation of car-sharing schemes, by estimating the relationships that exist between the performance of schemes, the policy environment in which they operate, and the nature of the schemes themselves,

and so predict the likely impact of schemes that operate under a variety of conditions.

Although field trials must obviously constitute the final test of the performance of car-sharing schemes, it was decided to base the current investigation on calibrated models. The models allowed us to experiment with a wider range of options than would have been possible in field trials and enabled us to gauge the likely scale of impact on public transport (a desirable preliminary since this impact could be very important).

Several studies have suggested that organized work-journey car sharing has the potential to have a large effect on the transport system (4,5). Given this potential impact, the problem is how to estimate the likely impact. Valuable work in the United States (6,7) has treated car sharing as a separate mode and has estimated demand by simple extension of existing modeling techniques. However, these techniques cannot produce accurate estimates since they do not consider the compatibility of carpool members (compatibility of location, journey time, and personality). Other work has concentrated on attitudes toward car sharing (8-12). It has provided useful insights into the likely behavior and compatibility of individuals but it is, in itself, not readily adapted for predictive purposes because it is concerned with individuals rather than populations and cannot consider the likelihood that the compatibility constraints will be met.