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**Mr. Tannir was with the New York State Department of Transportation when this research was performed.*

Traffic Impacts of Work-Schedule Changes in Medium-Sized Urban Areas

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A test is made of the hypothesis that changes in work schedules can significantly reduce traffic congestion in medium-sized automobile-oriented cities. By using an extreme case—a single high-density employer in a residential area—estimates are made of the change in peak trips that would result from three alternative work-schedule changes. The impact on the surrounding street system is then evaluated by using traffic-assignment techniques. Results show that even a maximum-impact policy (4-d work-week) would have only a marginal effect on local traffic, reducing regional travel costs by 0.4 percent and costs in the immediate surrounding area by 2.2 percent. Of all the traffic benefits accrued, over 90 percent flow to actual participants, primarily through the reduced number of required work trips. Because of the institutional problems associated with implementing such policies on a large scale, it is concluded that efforts to reduce highway congestion in medium-sized automobile-oriented cities by use of alternative work schedules may not be cost-effective.

The congestion-reducing approach of shifting travel in time and space so as to fit it within existing system capacity is receiving increasing attention. Numerous recent studies (1, 2, 3) describe the potential savings in traffic congestion achievable through such methods, and

recent federal guidelines on transportation systems management require the analysis of such methods on a continuing basis. Some of the most attractive demand-shifting approaches involve the shifting of work schedules to permit greater use of limited facility capacity over a longer peak period. Work-shift policies have been given considerable attention in relation to transit service, and it has been concluded that such policies are capable of reducing peak-period congestion in transit facilities (particularly terminals and stations) by as much as 10 to 30 percent. However, considerably less is known about the effect of such policies on highway operations, particularly in small or medium-sized urban areas. Although several studies (2, 4, 5) have identified potential reductions in congestion as one of the primary benefits of such proposals, it is clear that cities in which a large portion of peak-hour trips do not currently use transit services will find the implementation of work-schedule changes a less feasible method of reducing congestion than larger urban areas might find it to be.

This paper is one of several (6, 7) that have investigated employee attitudes toward work-schedule changes and the impacts of such schedule changes on highway networks in medium-sized cities. The emphasis of this study is on cities in which the automobile is the primary transportation mode and public transportation services and their use are at a minimum because it is believed that such findings are more applicable to cities in the United States and elsewhere than are the findings of studies of transit services. There are only a few cities large enough to warrant transit service studies.

STUDY LOCATION

The site selected for analysis was the State Campus in Albany, New York. The site is ideally suited for the analysis: It is a "spike" of employment (10 000 employees) in an otherwise residential area, New York State is the only employer on the site, patterns of employee work travel are primarily automobile-oriented, and transit plays a minor role in access to the site.

EMPLOYEE ATTITUDES TOWARD WORK SCHEDULES

The main office of the New York State Department of Transportation (NYSDOT), which has approximately 1771 employees, was selected as the agency for the employee survey. A representative sample of 110 employees returned a questionnaire on travel patterns, attitudes toward work-schedule arrangements, and relative importance of the attributes of such programs. The following three policies (7) generated the greatest support against the current 5-d fixed-time policy:

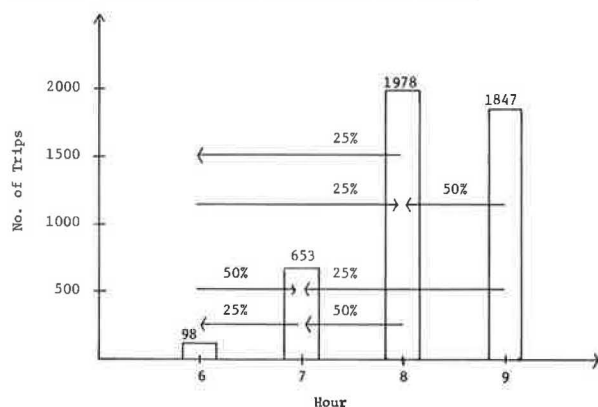
1. A 5-d workweek with variable work hours (73 percent support),
2. A 4-d workweek with variable work hours (65 percent support), and
3. A 5-d workweek with individual-specific work hours (65 percent support).

A full analysis of the results is available in a report by Tannir (6) and in a paper by Tannir and Hartgen elsewhere in this Record. The general conclusion of the survey, however, was that attitudes toward alternative work schedules are influenced primarily by the desire of employees to increase flexibility in their personal and family lives.

SHIFTS IN PEAK-PERIOD TRAVEL

The following analysis shows how trip ends were calcu-

Figure 1. Trip shifts by hour of day (4-d workweek).



lated for a 4-d workweek policy. Data on the percentage of trips that currently arrive at the campus during the peak (morning) hours are available from traffic counts. Of the trips that arrive each hour, it is assumed that 65 percent (from the employee survey) would shift to a 4-d workweek, which results in the data given below (total trips are based on 10 042 daily employees):

Hour of Day (a.m.)	Percentage of 24-h Trip Ends	Trips		Total
		65 Percent Shifting to 4-d Schedule	35 Percent Not Shifting to 4-d Schedule	
5:00-6:00	1.5	98	53	151
6:00-7:00	10.0	653	352	1005
7:00-8:00	30.3	1978	1065	3043
8:00-9:00	28.3	1847	995	2842

The new distribution of arrival times under the new policy can be calculated as follows. Trips not shifting to the new policy are assumed to stay at their present arrival times. For trips shifting to the new policy, the survey data show that between about 25 and 50 percent will move backward or forward in time to accommodate the new schedule (Figure 1). Thus, for example, the final arrival-time distribution for 5:00 to 6:00 a.m. can be calculated as follows:

Category	Number of Trips
Trips opting not to shift to new policy	53
Trips shifting to new policy	
Staying at 5:00-6:00 a.m. arrival time (0.25) (98)	= 25
Moving to 5:00-6:00 a.m. from 6:00-7:00 a.m. (0.25) (653)	= 62
Moving to 5:00-6:00 a.m. from 7:00-8:00 a.m. (0.25) (1978)	= 495
Moving to 5:00-6:00 a.m. from 8:00-9:00 a.m. (0) (1847)	= 0
Total	735

Similarly, trip ends for other time periods can be calculated as follows:

Arrival Period (a.m.)	Number of Trips				Difference (%)
	Remaining on Original Schedule	On 4-d-Workweek Schedule	Total	Original Distribution	
5:00-6:00	53	682	735	151	
6:00-7:00	352	1500	1852	1005	
7:00-8:00	1065	1112	2177	3043	-28.4
8:00-9:00	995	0	995	2842	

These data show that the 7:00 to 8:00 a.m. period is still the peak hour but the peak is much flatter. The reduction in peak-hour traffic is 28.4 percent. In similar fashion, percentage reductions for the other two feasible policies are estimated at 4.0 and 6.0 percent respectively. Since the 4-d-workweek policy results in the greatest reduction by far in peak-hour demands for the campus area, the analysis of the impact on the local street system was continued for this policy only. It is assumed that other policies that result in a smaller reduction in peak-hour demand would have less impact on local street congestion.

TRAFFIC ASSIGNMENT

The NYSDOT traffic-assignment model was then used to estimate the impact of the reduction in peak-hour demand on the local street system. The NYSDOT package is similar to the well-known Urban Mass Transportation

Table 1. Highway system operating conditions: null versus 4-d workweek.

Item	Total System			District 38		
	Vehicle Kilometers of Capacity	Vehicle Kilometers of Travel	Speed (km/h)	Vehicle Kilometers of Capacity	Vehicle Kilometers of Travel	Speed (km/h)
Condition						
Null	6 285 300	1 539 200	29.84	339 700	69 000	25.00
Test	6 277 700	1 536 500	30.00	334 500	67 700	25.32
Change (Δ)	-7 600	-2 700	+0.16	-5 200	-1 300	+1.3
Percentage change	-0.1	-0.2	+0.5	-1.5	-1.9	+1.3

Note: 1 km = 0.62 mile.

Table 2. Impact of 4-d workweek on vehicle kilometers of travel.

Location	Vehicle Kilometers of Travel on Arterials			Vehicle Kilometers of Travel on Expressways		
	Null	Test	Difference (%)	Null	Test	Difference (%)
Campus area	82	79	-3.9	413	374	-9.4
Ring 1	1669	1669	0	3434	3405	-0.8
Ring 2	4184	4152	0.8	3050	3019	-1.0
Ring 3	1287	1289	+0.1	1195	1185	-0.7

Note: 1 km = 0.62 mile.

Administration package and operates by assigning trips over minimum time trees computed through the highway network. Full capacity-restraint options and distribution of trip ends by means of the opportunity model were used in the tests. The testing sequence to estimate the impact on the local street network was as follows:

1. Determine the flow of present (null case) traffic by conducting a full traffic assignment with the campus zone (49) at the current number of vehicle trips ($N = 6396$);
2. Determine the spatial extent of the traffic impact caused by the 4-d-workweek policy by running an assignment with the campus-zone trip ends reduced to 4542 (28 percent reduction as determined above);
3. Quantify the impact of this reduction on local travel by comparing vehicle kilometers of travel by zone and link type in the above two tests; and
4. Determine the actual travel impact of the policy by rerunning the full assignment with adjusted peak-hour factors to represent the smoother flow conditions in the peak hours generated by the removal of some of the campus-bound trips.

RESULTS

A summary of the existing null conditions is given in Table 1. Of interest is the average speed on the network of 29.84 km/h (18.5 mph). This speed is the average of all speeds on all the network segments over a 24-h period. It takes into consideration speeds under free-flow conditions (usually high) and congested conditions (usually low). Note that district 38, which contains the campus zone, has an average operating speed of 25 km/h (15.5 mph).

A second traffic assignment was run to project traffic volumes under the conditions of the 4-d workweek. This run was identical to the first assignment except that the number of vehicle trip ends in the campus zone was reduced from 6396 to 4542. This run simulates the situation in which all State Campus employees are given an opportunity to be on a 4-d workweek. The results of this test are given in Table 2. Generally, the decrease in traffic volumes is slight. The drop in traffic of 3.9 percent on arterials and 9.4 percent on expressways in the campus area is clearly a much smaller drop than the 28 percent reduction in trip ends that caused it.

Table 2 also indicates that the effect of the 4-d workweek is highly localized around the campus area and dissipates quickly through the surrounding zone structure. Since this effect is entirely peak-hour travel, new peak-hour factors may now be computed for each affected zone that showed a reduction in vehicle kilometers of travel. The new peak-hour factors are computed by applying the percentage difference between the vehicle kilometers of travel to the base peak-hour factors in the null condition. The new peak-hour factors thus computed are used to update the distribution of trips among the various zones and network lines.

The analysis above assumes that the trips "removed" from the peak hour actually disappear—i.e., are not made. This is not the case: All of these trips are being made but at periods other than the peak hour. This means that only a small degree of relief in the traffic volume is expected to result from such reduction in the peak-hour demand.

To simulate this effect, the second assignment took into consideration the new peak-hour factors. Results are summarized in Table 1 ("null") and the following table [the economic analysis assumes 1970 dollars and a value of time of about \$2.75/h (7)]:

Item	Benefits (\$)		
	From Smoother Traffic	From Trips Not Made	Total
Travel time	710	6664	7 374
Operation	73	2215	2 288
Accidents	12	352	364
Total	795	9231	10 026

Clearly, these results show only minimal impact as a result of even this extreme policy. A comparison of the two tests reveals that the daily travel cost savings to the region from the institution of a 4-d workweek on the State Campus would be only \$795. These savings are concentrated in the immediate area surrounding the campus (district 38). Significantly greater travel savings also accrue directly to State Campus employees who participate in the program as a result of the 20 percent reduction in weekly work trips (table above).

CONCLUSIONS

The central conclusions of this paper are the following:

1. The congestion-reducing impact of alternative work-schedule policies in highway-oriented cities is small. Even in surrounding areas of high employment, the impact dissipates quickly into the surrounding traffic.
2. Transportation benefits will accrue primarily to those who participate in such programs as a result of (a) the reduced number of required work trips and (b) avoidance of peak-period congestion. The general (non-participating) peak-hour commuting public will benefit only marginally.

These findings are particularly disturbing because they are based on an ideal test: A single, high-density, white-collar employer is assumed to adopt the policy that has maximum potential traffic impact. Most cities, however, have a wide mixture of types of employers and jobs dispersed over a wider area, and these employers are not all likely to choose the same policy. In central business districts, where work concentrations are high, the cooperation of numerous small employers may be difficult to achieve. Hence, in the general case, the congestion-reducing potential of work-schedule changes in automobile-oriented cities is probably small. Given the inherent problems of implementing such policies on a broad scale, even in small communities, the results here suggest that the traffic-reduction payoff may not be significant. These findings further suggest that, in the vast majority of American cities, transportation planners should not view alternative work schedules as a panacea to effectively reduce traffic congestion. Attempts to implement such policies, therefore, should not be motivated solely by potential reductions of traffic congestion but also by the other real personal benefits in job and family activities that they can provide.

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Development of the California Transportation Plan: 1973-1977

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The California Transportation Board adopted Recommended Statewide Transportation Goals, Policies, and Objectives in March 1977, marking completion of the first of six elements of a comprehensive transportation plan that 1972 legislation originally had mandated must be completed by January 1, 1976. Because of administration and public criticism of the first draft and legislative failure to adopt the necessary transportation goals and policies, that mandate could not be fulfilled. The controversy that arose over the initial plan element suggests that remaining elements may not be completed. However, the California Transportation Board feels that several recommendations in the completed (or policy) element may eventually be adopted, if only piecemeal. This paper describes the evolution of the California Transportation Plan from development of the initial draft by the California Department of Transportation through various iterations and examines the difficulties that surround creation of an objective document in the face of interests that benefit from maintaining the status quo.

In March 1977, the California Transportation Board adopted Recommended Statewide Transportation Goals, Policies, and Objectives. This action was the culmination of 4 years of work that, although it did not result in a completed plan, represented an intensive cooperative effort by the board, its staff, the California Department of Transportation (Caltrans), and an interdisciplinary task force.

The goals, policies, and objectives (or policy) element was the first and most important segment of the plan because it was to guide development of the remaining four elements. That the plan did not advance beyond this element was attributable to the controversy that enveloped this first stage. Legislation that mandated the