THE USE OF STAGGERED WORK HOURS TO REDUCE CONGESTION

by

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Prepared for
CVEN 689
Advanced Surface Transportation Systems

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August 1993

SUMMARY

Over the years, the traffic congestion problem in most urban areas has grown from a mere annoyance to a major problem. This congestion can be found on the freeways serving and surrounding the central business district of any major metropolitan area. The predominant contributor to this congestion is the morning and afternoon peaking of travel demand which is brought about by the existing 8:00 AM to 5:00 PM work hours. Therefore, methods to reduce or alleviate this congestion must focus on trips to and from work.

Staggering work hours is a method of reducing congestion by focusing on work trips. The fundamental purpose of staggered work hours is to flatten the peak concentration of commuter travel demand by changing the time-of-day distribution of worker arrivals and departures. Before the implementation of a staggered work hours program, however, the impacts of such a schedule change on transportation, the workplace and the employee must be assessed. Further, the implementation of staggered work hours takes intensive planning and organization to be successful. The advantages and disadvantages of such a program must be weighed against each other to speculate what overall impact the program will have on those involved. Finally, solutions to the barriers of staggered work hours should be sought in an attempt to gain public acceptance and participation in the project.

This paper includes a review of the literature, suggestions of possible solutions to the barriers of staggered work hours, and implementation needs to produce a successful staggered work hours program. Further, implementation steps are illustrated through a case study in the Simi Valley in northern Los Angeles, California. Recommendations are then made regarding a site in Houston, Texas which might benefit from a staggered work hours program.

Based on the analysis herein, the following recommendations are made:

1. Staggered work hours should be used to help reduce recurring congestion on city streets and freeways in medium to large urban areas. A lead agency should be established to plan, organize, and coordinate the program in an attempt to maximize congestion reduction, satisfy employers and meet the needs of employees. The lead agency should organize an employers' group to encourage participation, help target the employees, and establish a communication link between the lead agency and the work organizations.

2. Staggered work hours programs should be implemented in a multi-staged approach in order to better concentrate on the impacts of the project on transportation, the work organizations, and the employees. After the impacts of each stage of the program have been assessed, modifications to the program should be made with respect to the impacts observed and input from the employers' group. It is expected that the benefits gained from the use of staggered work hours will help further promote the program, and that eventually, employees will form their lifestyles around the new work schedules.

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INTRODUCTION

Traffic congestion is a major problem facing most urban areas today. Several recent opinion surveys on ranking community problems have shown that urban residents rank traffic as the number one problem or the number two problem, second only to crime (1). Although many efforts have been made to relieve congestion, it continues to be a growing problem. Congestion occurs when traffic demand exceeds roadway capacity. Traditional attempts at reducing congestion involve the addition of capacity; today however, this addition is not always feasible due to limited right-of-way and environmental concerns. Further, the addition of capacity will, in many cases, stimulate latent demand after traffic conditions improve. Congestion is, thus, pushed back to the level it was before the improvements were made, creating a "congestion cycle" (2). More recent methods of relieving congestion have shifted toward managing traffic demand in addition to managing roadway capacity, which is known as transportation systems management (TSM).

Background

Giuliano and Golob explain, "Transportation demand management (TDM) is a derivative of transportation system management which was popularized in the 1970s when transportation planners focused on increasing the efficiency or productivity of the transportation system in response to the energy crisis and air quality concerns. TSM includes both supply- and demand-oriented strategies, such as ramp metering, signal coordination, and provision of high-occupancy-vehicle lanes" (1). As mentioned earlier, TDM has replaced many of the earlier ideas of supply management as efforts to reduce demand are in action. A key feature to this shift is the notion that travel demand is not necessarily absolute and can, to some degree, be managed (3). With this in mind, various methods of managing travel demand must continue to be developed. Travel demand management techniques cannot be made successful, however, unless the nature of the congestion is fully understood.

Severe congestion during peak periods does not occur uniformly, but usually occurs in corridors and subareas where commuter travel demands are especially heavy. Central business districts (CBDs) and the radial highway and transit routes serving them often suffer the worst congestion (3). Existing work hours (8:00 am - 5:00 pm) greatly contribute to the twice-a-day peaks which cause this congestion.

Nature of peaking and its effects on highway transportation

The scheduling of work hours could be the root of the congestion problem due to the abundance of commuters using the freeways to travel to and from work. Figure 1 depicts the hourly distribution of vehicle work travel and total travel averaged for eight major cities throughout the United States. The data well represent the twice-daily peaks of travel demand. This escalating travel demand in the morning and evening is what causes congestion. Therefore, congestion could be relieved be spreading this peak distribution of travel demand over a longer time period. Thus, the approach to alleviating traffic congestion by flattening the peak travel demands must involve the alteration of work schedules (3).

Staggered work hours

One method of altering work schedules is to stagger work hours. The fundamental purpose of a staggered work hours program is to flatten the peak concentration of commuter travel demand by changing the time-of-day distribution of worker arrivals and departures. With staggered work hours, groups of employees work on fixed schedules with sequential or staggered start and end times. All employees in an organization work the same days each week and the same number of hours each workday. Daily starting and stopping times of different groups of workers within the organization are varied by the employer by assigning staggered starting times--7:00 am, 7:15, 7:30, etc.; or all employees within an organization can have the same work schedule while the work schedules of other organizations are earlier or later. Thus, work hours are staggered among organizations or within organizations. Employees generally have no choice in their working hours, as in flextime programs; they are simply expected to be present each day during their assigned times (3). The concept of staggered work hours as explained by Tannir (5) is based on the assumption that work staggering during the peak hour results in a change in temporal traffic demand so as to spread the peak hour volume over a longer period. The net effect of this change in demand is a decrease in traffic volume and a subsequent improvement in traffic conditions during the rush hours. Actual impacts of staggered work hours remain unclear, and although the impacts on traffic flow have been estimated, little empirical documentation is available.

Problem Statement

It has been found that most trips during the morning rush hour are to work and that most afternoon rush hour trips are work-to-home (5). Further, as D'Este explains, "The structure of most cities is that the majority of the work places are clustered around the city center thereby giving rise to a funneling effect as commuters who are initially widely distributed throughout the urban area gravitate toward the CBD" (6). Further, many large cities have multiple activity centers distributed throughout the metropolitan area which are interconnected by congested freeways. Therefore, with the existence of regular work hours, starting and stopping at the same time, and the structural configuration of most cities, roadways become saturated in the morning and afternoon while at other times during the day operate well below capacity. In attempting to find solutions to the congestion problem, then, it is necessary to focus on trips to and from work.

Scope of Research

This report is intended to provide insight into the issues and impacts pertaining to the use of staggered work hours as a traffic management technique. The report will focus on the purposes for work rescheduling, the resulting impacts on automobile transportation, and the positive and negative impacts of staggered work hour programs on the workplace and the employee. Further, implementation of staggered work hours programs will be discussed with regards to a case study area. Finally, recommendations will be made as to a location which might benefit from staggered work hours.

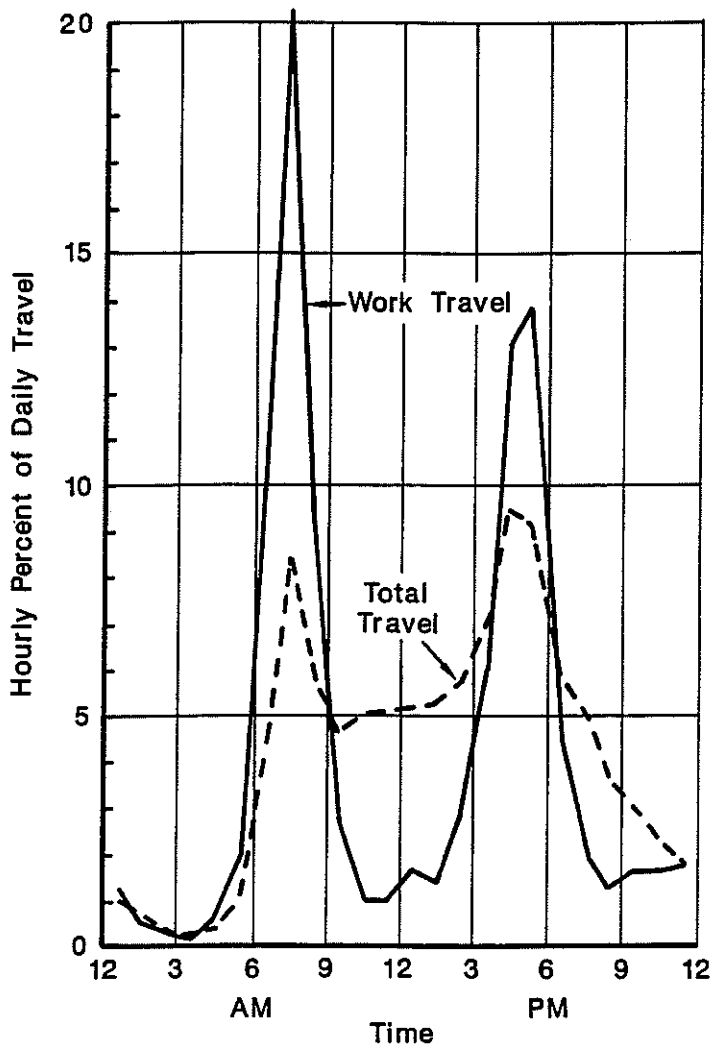

Figure 1. Hourly distribution of vehicular travel in selected urban areas (4).

The scope of this report will be narrowed to deal specifically with staggered work hours, and is not intended to be a review of all types of alternate work schedules due to the limited time available to complete the project. Although staggered work hours will have an effect on transit traffic, only the effects of staggered work hours on automobile traffic will be considered. A review of other alternate work schedules such as flexitime or compressed work weeks and the impacts of alternate work schedules on all modes of transportation, however, would be beneficial to the reader. The implementation of these programs could also be beneficial to the reduction or alleviation of congestion.

EXAMPLES OF STAGGERED WORK HOURS PROGRAMS

New York, New York

The Port Authority of New York and New Jersey implemented a variable work hours program in 1970 (7,8). Three thousand of its employees participated in the program. The major finding was that the change in schedule was feasible and even desirable. Subsequently, 50,000 employees representing 50 public and private organizations, all located in lower Manhattan, participated in a staggered work hours program. The objective was to determine if this number of participants (11 percent of the work force in lower Manhattan) would help alleviate the transportation congestion in the area. It was reported that this project had a significant effect in relieving congestion at certain sections of the transportation system serving lower Manhattan. Many New York City employees remain on variable and staggered work hours today.

Ottawa, Canada

On March 4, 1974, a pilot project known as the Ottawa-Carlton Variable Work Hours Plan (9) was implemented in the Ottawa-Carlton, Canada area. Canadian government employees in the central area of Ottawa were placed on a combination of staggered and flexible work hours. Nearly all of the 33,000 government employees participated in the program which amounted to 47 percent of the total number of workers in the Ottawa-Carlton central business district. The plan was initiated by the local Transit Authority, and a high degree of freedom was available to participants in choosing their own schedules. A follow-up study was conducted by the Transit Authority to analyze the impact of the schedule on modal split, transit ridership and capacity, automobile traffic distribution, parking, vehicle occupancy, and employee arrival and departure times. Results showed a reduction in peaking characteristics related to employee arrival and departure times and a significant affect on automobile distribution by the arrival and departure rates at parking facilities.

New York State Department of Transportation

In 1976, a case study was conducted by the New York State Department of Transportation and Rensselaer Polytechnic Institute (5) to determine feasible work schedules of staggered work hours and investigate their potential impacts on the operational efficiency of a highway network serving a high-density employment area in a medium size city, Albany, New York. Further objectives were to compute transportation benefits which may accrue, evaluate other work related benefits and to assess the effects on the organizations and its employees who may adopt such schedules. A sample of 140 employees from the main office of the New York State DOT in Albany were surveyed. Traffic simulation techniques were used to estimate changes in the operational efficiency of the transportation network. Survey results showed that support for alternative work schedules stems from the desire to reconcile one's work and personal activities, and that the most important factors influencing favorability of these schedules were leisure time, income, family size, age, congestion levels, and carpooling. It was concluded that the flexibility in

work schedules rather than the number or length of days worked was the primary reason underlying the support for work schedule changes. As for impacts on automobile transportation, the traffic simulations showed that the greatest impacts of alternate work schedules were expected to occur within a ring of two miles radius from the office site, the effect being less evident as the distance from the complex increases. Impacts on the organization and its employees were generally anticipated to be positive, especially on employee leisure, family time, job satisfaction, productivity, savings on gasoline, and rush hour commuting. However, the effects on employee fatigue and inter- and intra-agency communication may have been somewhat negative.

Honolulu, Hawaii

The four week Staggered Work Hours Demonstration Project (1) was conducted in downtown Honolulu, Hawaii from February 22 to March 18, 1988. During the project, official office hours for state, city, and county employees were shifted 45 minutes later in an attempt to alleviate the early peak-period congestion into downtown Honolulu. The shift to a later schedule was selected because of the early peaking characteristic of downtown-bound traffic. Approximately 3,500 of the 7,100 employees working in the Civic Center area participated in the project. All employees who filed for exemption were allowed not to participate. Also, 18 major corporations participated. The program was voluntary for these private sector employees, and a change in schedule could be either to an earlier or later one. General characteristics of participants were that they were car drivers, from households with less workers, and/or had a professional or technical occupation. Non-participants tended to be younger, women, had more children, used childcare, and/or were carpoolers or bus users. An 18 percent participation rate of the downtown work force was expected to produce a reduction in congestion; however, only 7 percent of the work force was involved. Travel time data, speed data, employee surveys, and employer surveys were collected to estimate the effects the change in work schedules had on automobile transportation, work organizations, and employees. The results showed an average estimated travel time savings of three to four minutes. Further, 80 percent of the employees polled were opposed to mandatory schedule changes, while 80 percent favored voluntary schedule changes. It was concluded by Giuliano and Golob (1) that a staggered work hours program would work only if it was voluntary.

Impacts on Transportation

The prominent reason for implementing a staggered work hours program is to relieve congestion in urban areas. Implementation of staggered work hours programs, then, is not necessary if it has no effect on transportation. Therefore, the effects of past staggered work hours programs must be evaluated to determine if any were successful in reducing congestion. There are three aspects of interest in the analysis of the effects staggered work hours have on transportation: distribution of work arrivals and departures, distribution of automobile traffic, and quality of highway service.

Distribution of work arrivals and departures

In staggering work hours, it is expected that the distribution of work arrival and departure times will be affected. If employees began to arrive at work at 7:00 am with groups of employees arriving every 15 minutes until 9:00 am, the cluster of arrivals that would normally arrive at 8:00 am would be spread over a two hour period, thus flattening the "peak" of arrivals. During the Staggered Work Hours Demonstration Project in Honolulu, Hawaii (1), however, there was a significant concentration of arrivals and departures at work sites. This was because all employees participating in the project were still beginning work at the same time (all shifted 45 minutes later), and those who had been arriving as early as 7:00 am before the mandatory schedule change were then arriving at the same time as all other employees. In essence, there was no staggering of public-sector work hours, only a shift in work arrival time. This shift, however, was staggered with respect to non-participants' work schedules. The private sector, on the other hand, did see a slight change in the peak distribution of work arrivals and departures. An increase in later arrival times resulted in the same distribution of arrivals during the project, but fewer workers arrived between 7:00 AM and 8:00 AM. This can be attributed to the voluntary nature of the project for private-sector employees as they were allowed to shift to an earlier or later work schedule. The arrival times of public and private sector employees before and during the project are illustrated in Figure 2 (1).

The results from the Port Authority of New York and New Jersey (7,8) staggered work hours program were similar to the Honolulu project regarding the shift seen in work arrival times; however, unlike the Honolulu (1) project, the peak arrival was greatly reduced at the Port Authority building after the implementation of staggered work hours. This shift and reduction in worker arrivals is shown in Figure 3. The dramatic flattening of the peak-period arrival patterns was caused by a 29 percent reduction (from 460 to 355) in the number of arrivals in the peak 5 minutes.

The most dramatic affects on the distribution of arrival and departure times was seen during the Ottawa (9) staggered work hours program. As shown in Figure 4, the morning 15-minute arrivals were reduced by 50 percent, and the afternoon peak 15-minute departures were reduced by almost 57 percent. Peak-hour arrivals and departures as a percentage of the three-hour peak-period totals in Ottawa were reduced by about 17 percent in the morning and by about 24 percent in the afternoon.

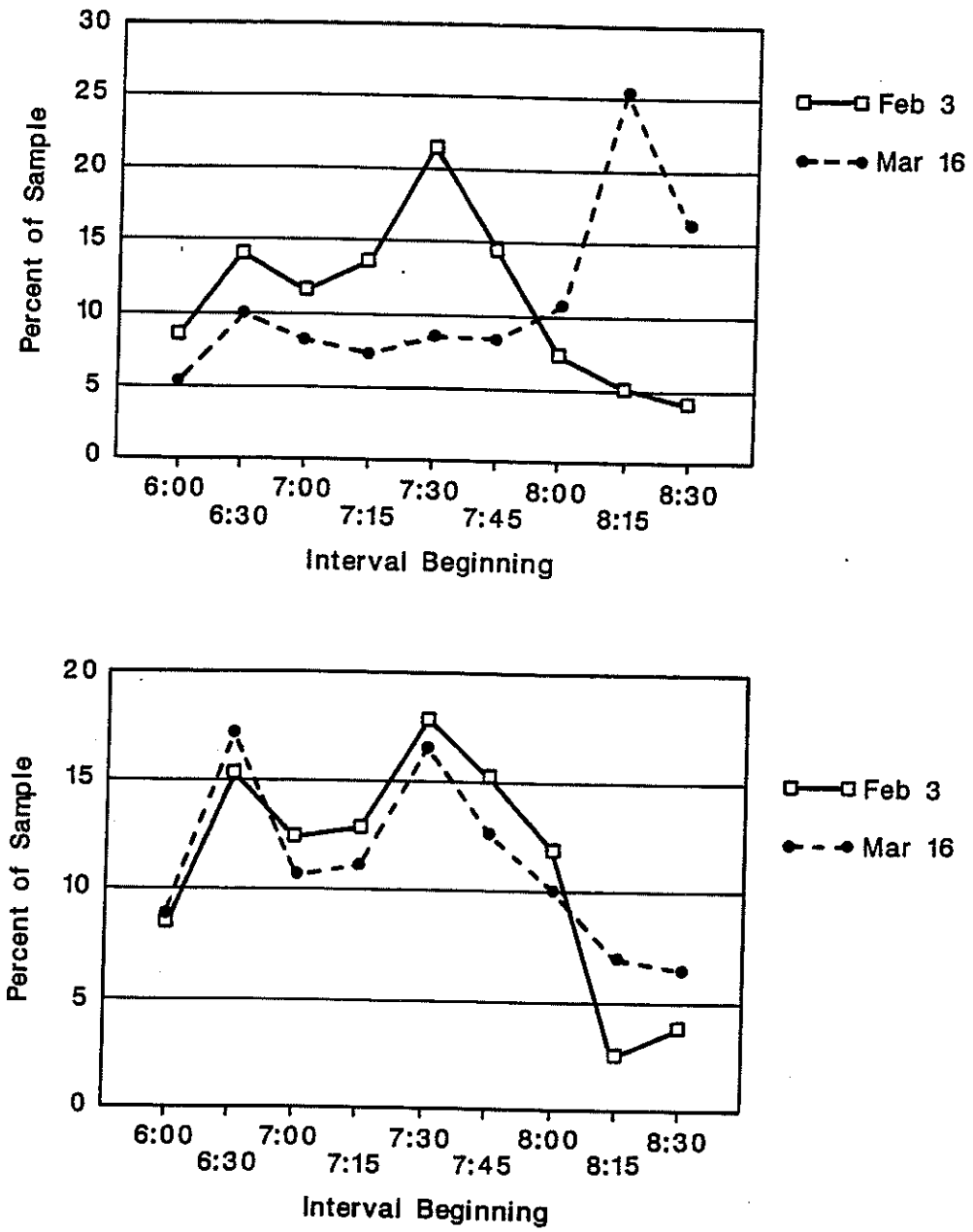

Figure 2. Arrival time at work for state (top) and private-sector employees (bottom) in Honolulu, Hawaii (1).

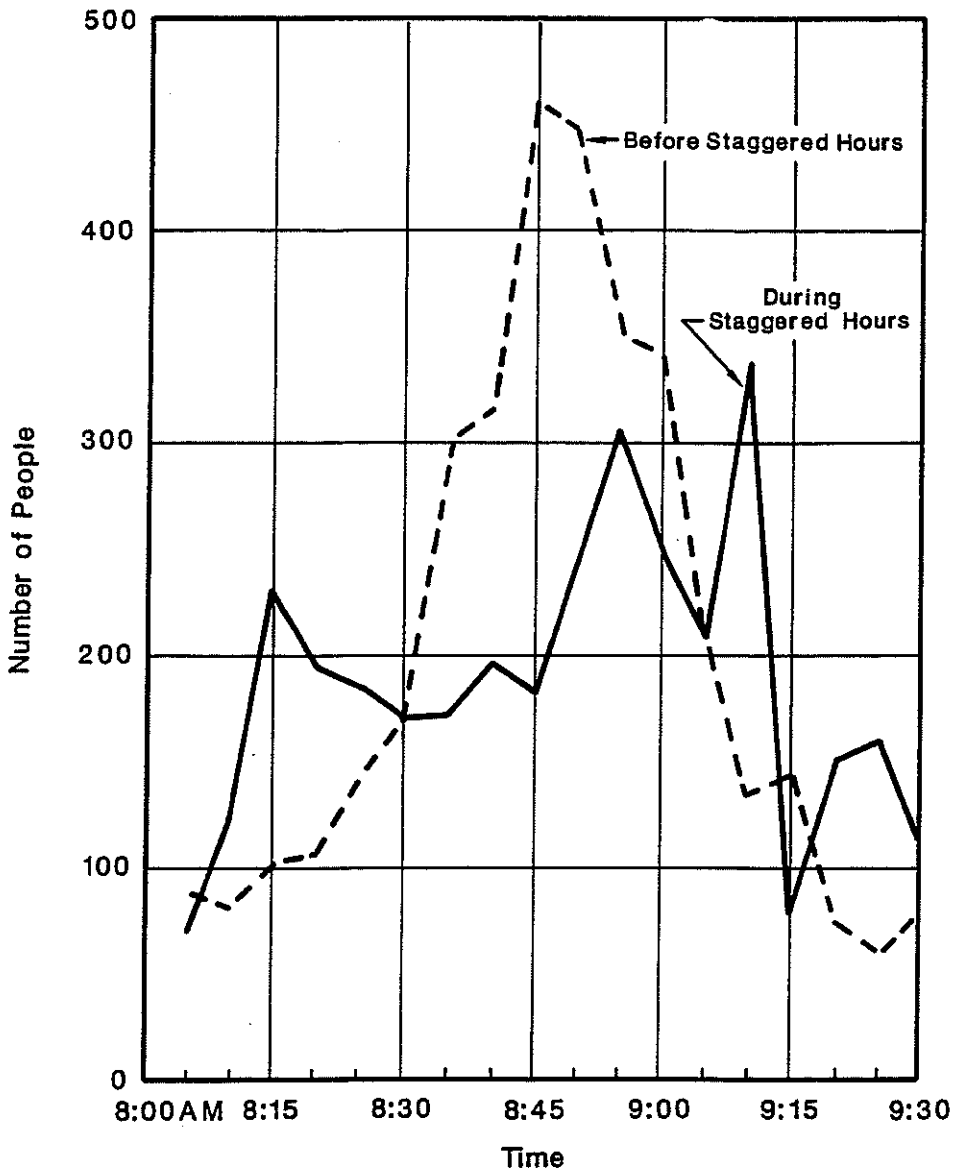

Figure 3. Impact of staggered work hours program on worker arrival times in the Port Authority building lobby in lower Manhattan (7).

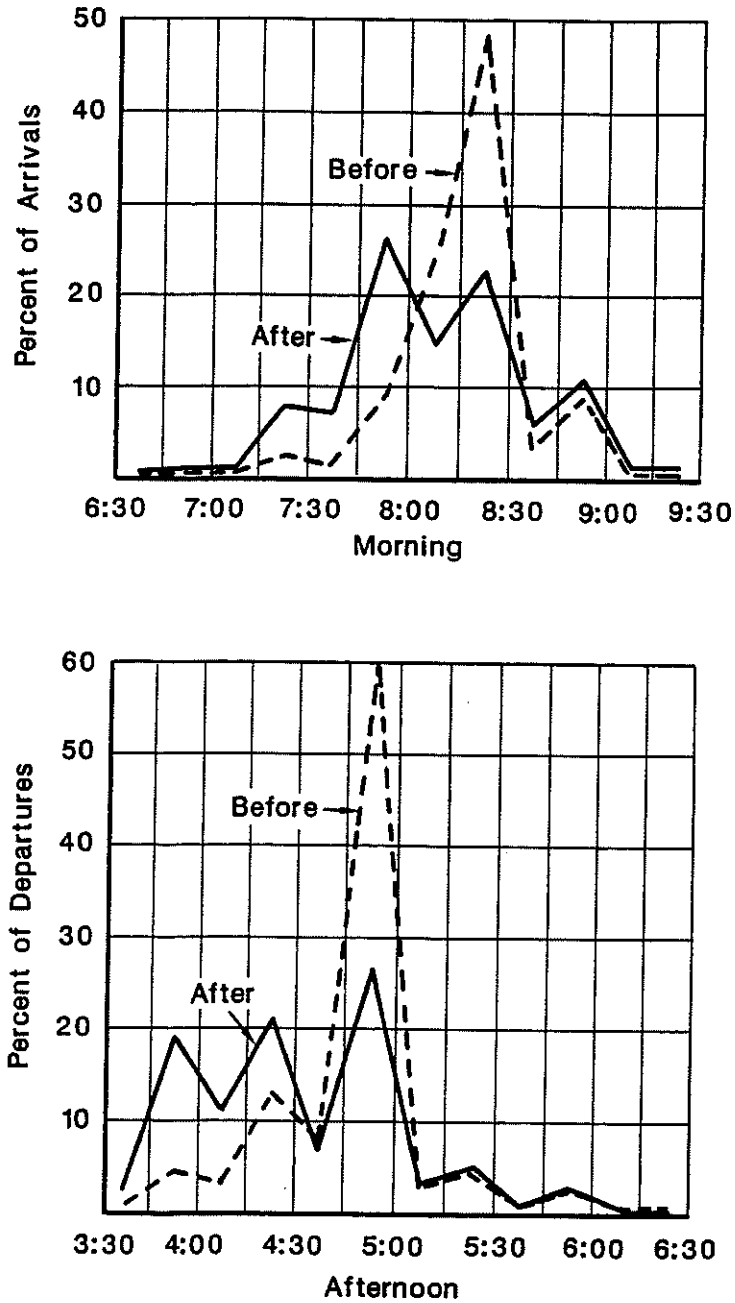

Figure 4. Impact of staggered work hours on government worker arrival and departure times in Ottawa (8).

Distribution of automobile traffic

It is the intention that the implementation of staggered work hours will spread the peak traffic demand over a longer period of time. There are, however, many factors influencing the distribution of traffic throughout the day. Not only are commuters travelling to and from work, other drivers are using the roadways for various reasons such as personal business, pleasure, vacationing and so on. It is, therefore, more difficult to observe the change in traffic distribution than that of the worker arrival and departure times.

Of the three projects reviewed, the Ottawa-Carlton Variable Work Hours Plan (9) was the most completely evaluated regarding the effects of staggered work hours on the distribution of peak-period travel demand. Vehicle counts were conducted at two screenlines, one corresponding to the limits of the Ottawa CBD and one farther away from the CBD which represented the Ottawa River which many regional commuters crossed. Both screenlines had a significant number of commuters whom were bound to or from the Ottawa CBD. The outer screenline, however, had a higher percentage of commuters making non-work trips. Figure 5 shows the time distribution of automobile volumes coming into and going out of the CBD during the morning and afternoon peak hours, respectively. After the implementation of the program, the morning peak 15-minute volume was 6 percent lower and occurred 15 minutes earlier. This decrease is somewhat disguised, however, because the traffic volume before and after the project, for unstated reasons, increased by 10 percent. Therefore, the peak 15-minute volume actually decreased by about 15 percent. The change in peak-period automobile traffic distribution was more significant in the afternoon. The 15-minute peak period shifted an hour earlier and dropped 17 percent, which corresponds to a 22 percent decrease in peak 15-minute volumes due to the 6 percent increase in overall peak-afternoon volume.

The impact of the staggered work hours program at the outer screenline was less obvious, as this area contained a smaller portion of CBD work trips than the area adjacent to the CBD. Considering the increase in overall peak period volumes, the morning peak 15-minute volume decreased by 13 percent, and the afternoon peak 15-minute volume decreased by 9 percent.

Peak-period distribution of automobile traffic in Manhattan was also analyzed during the study by the Port Authority of New York and New Jersey (7,8) for the impact of the staggered work hours program. Volume counts were conducted at the Midtown Tunnel, the Lincoln Tunnel, and the George Washington Bridge. The findings showed no significant reshaping of the peak-period distribution at these locations. The lack of reshaping was attributed to the very long, flat peak traffic periods which existed before the staggered work hours program was implemented. Because the facilities were loaded to near-capacity conditions for virtually three hours in the morning and afternoon, there was little to no available capacity on the "outer edges" of the peak to attract further shifts in commuting times. Further, because less than 50 percent of trips through these facilities were work trips and only about 10 percent of Manhattan workers took their vehicles, it is understandable that no discernible redistribution of automobile peaking resulted from the implementation of staggered work hours.

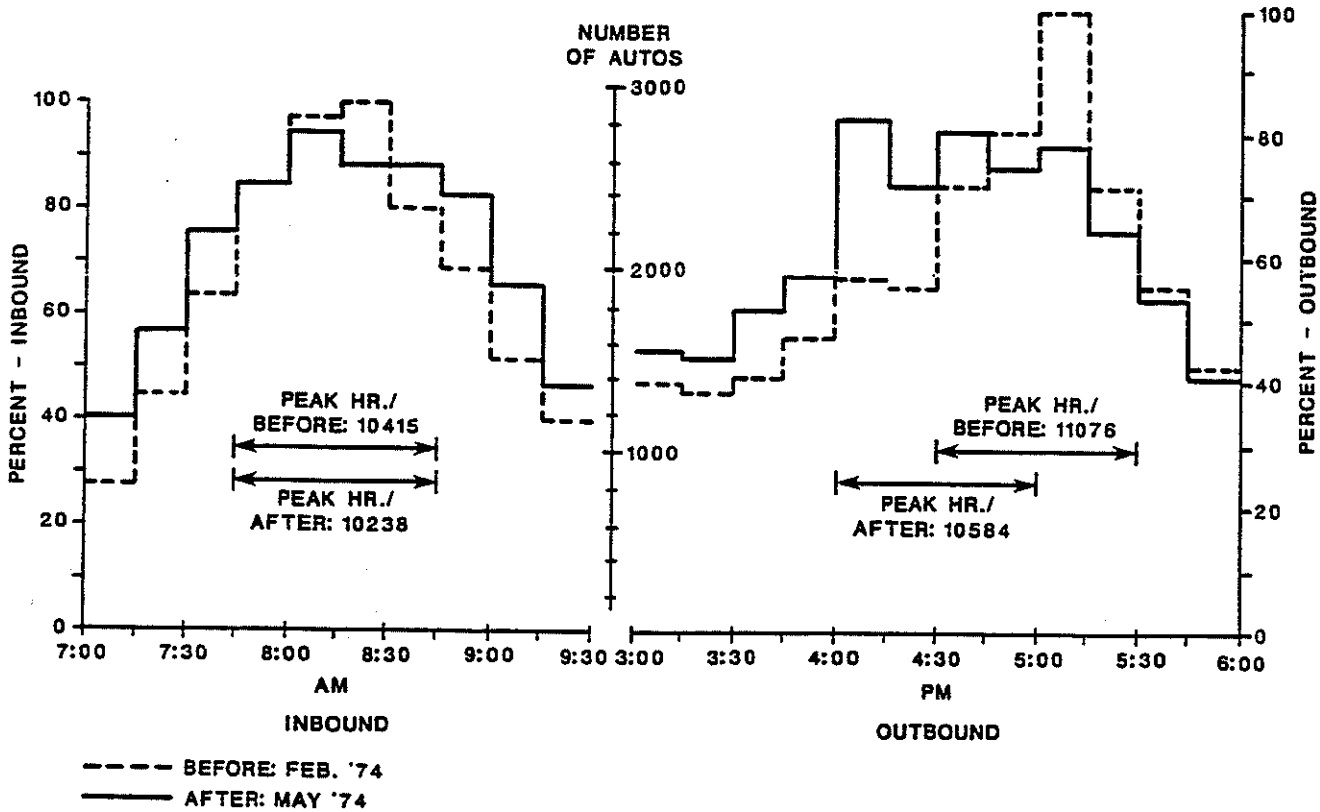

Figure 5. Impact of staggered work hours on automobile volumes at the Ottawa central area screenline (9).

Quality of highway service

The purpose of flattening peak-period demands through staggered work hours is to increase the quality of service provided by the highway system. The quality of service can be increased by decreasing congestion. A decrease in congestion leads to increased speeds and travel times, improved safety on the roadway and decreased fuel consumption. Although travel time savings is probably the most positive effect that can come from the implementation of staggered work hours programs, little information has been collected or documented regarding the effects of staggered work hours on travel time. Much of the literature is based on commuter perception of commuting experience or estimates based on the redistribution of peak-period transportation demand (5).

There was a positive overall effect on traffic conditions during the Honolulu (1) staggered work hours program as there was an estimated 3 percent savings in consumed fuel and a reduction in travel time. Travel time savings were experienced in the earlier time intervals (before 7:30 am); however, these savings were somewhat offset by travel time losses in later time intervals (probably due to the 45 minute shift to a later schedule by public-sector employees. Overall, the average travel time decreased by 3 to 4 minutes, 7 to 9 percent of the average 45-minute commute. This savings, however, probably went unnoticed to many commuters.

Although there was no significant reshaping of the peak period traffic loads by the staggered work hours program implemented by the Port Authority of New York and New Jersey (7,8), 57 percent of the commuters reported their commuting time improved.

Finally, in the study completed by the New York State Department of Transportation (5), it was concluded that the impact of a staggered work hours program on the highway network was minimal beyond a 6-mile radius from the studied CBD.

In summary, staggered work hours have been found to have a positive effect on transportation. Staggered work hours do help redistribute the peak-period travel demand; however, the most pronounced effects of changes in work schedules are those on work-trip arrivals and departures. Further, data from a number of studies show a reduction in travel times from 2.5 minutes to 8 minutes per trip for participants in the staggered work hours program and 1 minute to 4 minutes for all commuters (5). Finally, the impact of work schedule changes decreases as the distance of the highway from the employment center increases; and, the impacts of work schedule changes are weakened by the travel of commuters not participating in the staggered work hours program and by non-work traffic in the network (5). Therefore, the success of a staggered work hours program is highly dependent on the number of participants and the proximity of the employment center to the congested freeways.

Impacts on the Workplace

An important consideration in the alteration of work schedules is the impact that the change will have on the workplace and its ability to function as if no change has taken place. It is crucial that productivity, communication and employee morale remain at acceptable levels and that employers remain satisfied with the operation of the work organization. In the majority of the staggered work hours programs that have been implemented, impacts on the organization were carefully analyzed to determine if the alteration of the work schedules had a more positive or negative effect on the workplace.

When employers involved in the Honolulu Staggered Work Hours Demonstration Project (1) were asked to rate employees' overall performance, private-sector managers reported no change in conditions. The public-sector managers, on the other hand, were more likely to report the same or worse conditions. When asked about employee moral, private-sector managers reported the same or better conditions, while about half of the public-sector employers reported worse or much worse conditions. Work activities such as managing, communication, scheduling, and making contacts were found to be mostly unaffected by the project, while inter- and intra-organization coordination was found to be negatively affected by the project. In general, the project had few negative effects of the work organizations. The lower level of performance and moral by the public-sector employees was attributed to the mandatory participation required of these employees. Private-sector employee production and morale was affected less negatively because their participation was optional, and those who chose to participate were most likely doing so for their personal benefit.

Another impact of staggered work hours on work organizations is the effect this type of program can have on reducing crowding in parking lots and on elevators. Data collected by the Port Authority of New York and New Jersey (7,8) showed the reduction of delay to elevator passengers by almost 60 percent; and for those delayed, the average waiting time was reduced by 81 seconds. Although elevator transit times were not reported, it is expected that they would also be reduced, as the longest times would almost certainly be when the elevators were loaded to capacity. This reduction in waiting time will also reduce overall work-trip travel time which includes parking and walking to and from one's office.

With regards to parking lot congestion, a concentration of arrivals and departures can cause queuing at the entrance or exits and within the parking facility. Although no quantitative data of the effects of staggered work hours on parking facilities were collected in any of the staggered work hours programs discussed herein, it has been shown in the literature that the peak arrival and departure rates of commuters has been significantly redistributed. Therefore, it follows that parking lot congestion could also be reduced as a result of a staggered work hours program.

The staggered work hours program implemented by the New York State Department of Transportation (5) involved a survey of managers and supervisors to assess the impacts the program had on its workplace. The issues addressed in the survey included productivity, morale, communication, and job satisfaction. Although affects of these issues are hard to measure, the response to anticipated impacts is a measure of the effects of schedule changes

on the organization. Responses to the questions could be answered by choosing the nature of the impacts as: very negative, somewhat negative, neutral, somewhat positive, or very positive. The results of the survey show various opinions on the effects of staggered work hours on the workplace. Managers generally reported that a change to staggered work hours would not have negative effects on the agency's productivity, employee morale and job satisfaction; however, they felt that inter- and intra-agency communications would be negatively affected. Supervisors were generally more optimistic about the impacts of staggered work hours on the agency than the managers. The majority of the supervisors felt that productivity and job satisfaction would be improved and that communication would be unaffected.

It is difficult to quantify the impacts of staggered work hours programs on a work organization. Further, every workplace has its own characteristics such as work environment, communication methods, organizational structure, etc.. Therefore, it is impossible to generalize the opinions of one or two organization's employers to describe the impacts of staggered work hours on every workplace. It is, however, beneficial to those implementing a staggered work hours program to determine the employers' feelings who have experienced such a schedule change in an effort to maximize the benefits reaped from a newly implemented staggered work hours program.

Impacts on the Employee

The impacts of staggered work hours on the workplace are important, however, the impacts these schedule changes have on employees is probably one of the most important factors behind the success of a staggered work hours program. Because a work schedule change has the greatest overall effect on the employee, it seems logical that the change should be made so as to benefit the employee in an effort to encourage positive attitudes and willing participation. The mandatory changes brought about by a staggered work hours program, however, can cause negative attitude towards the program, especially if the employees see no benefits to making the changes. Moreover, if the employee's schedule change effects aspects of his or her personal life such as spending time with the family, the success of a staggered work hours program will be limited. Of the staggered work hours programs that have been discussed herein, several have looked at the effects that the programs have had on the employee.

As discussed earlier, the Honolulu Staggered Work Hours Demonstration Project (1) was mandatory for public-sector employees and optional for private-sector employees. When managers were asked to report their employees' attitudes toward the project before, during and after its implementation, private-sector ratings were very positive and public-sector ratings were negative. However, the negative attitudes held by public-sector employees before the implementation of the project became less so during and after the implementation as shown in Figure 6. Very negative and negative responses became less negative, more managers reported employee indifference toward the project, and more employees felt positively about the staggered work hours during and after the project. In other words, after the project, about 70 percent of state employees had either neutral or positive attitudes towards it. Further responses to the implementation of the staggered work hours program in Honolulu indicate a strong opposition to mandatory programs by both the

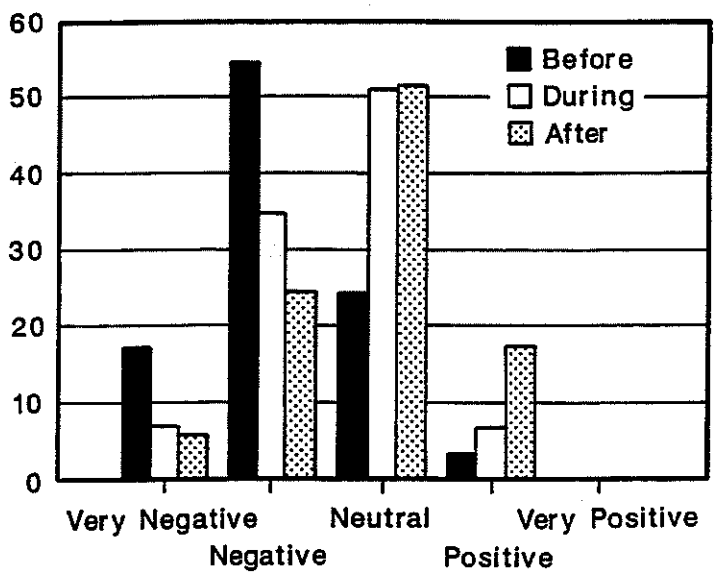

Figure 6. State employee attitudes toward the Honolulu project as reported by managers (1).

public- and private-sector participants and non-participants. Voluntary staggered work hours alternatives, however, were viewed more positively by employee participants and non-participants. Many of the negative attitudes towards a mandatory staggered work hours program were contributed to the effects this type of a schedule change would have on the employee's personal life. Several complaints regarding the work hour changes included not being able to take care of personal business, trouble scheduling social activities and not enough time to spend with the family. Other problems reported by those on later schedules were problems finding parking spaces and problems using express bus service.

In regards to the staggered work hours program implemented by the New York State Department of Transportation (5), general employee attitudes were obtained from a survey given to the employees to determine the consequences of the work schedule changes. Survey results are presented in Table 1. In general, the majority of the responses to all issues were neutral or positive.

Some lessons have been learned through the responses of employees regarding their attitudes towards staggered work hours programs. One lesson learned is that employees seem to prefer earlier to later work schedules. In other words, they would rather come to work earlier in the morning and get off work earlier in the afternoon. Another lesson learned is that the penalization of late arrivers must be eliminated. This penalization exists in the form of first-come, first-serve parking and express transit services which stop serving at 5 pm. Further, more incentives need to be offered in order to encourage employees to change work schedules. Once employees have changed and begin noticing the benefits of staggered work hours including a reduction in congestion, more participants will follow.

Table 1. Employee responses to the impacts of the NYSDOT staggered work hours program[a] (4).

Impacts on	Nature of staggered work hours impacts on employees				
	Very Negative	Somewhat Negative	Neutral	Somewhat Positive	Very Positive
Second Job	25	4	47	17	7
Fatigue	9	16	46	12	17
Communication	4	7	59	19	11
Rush Hour Commuting	14	8	42	18	18
Leave Time	4	7	48	17	24
Gas Savings	6	3	51	21	19
Productivity	0	8	48	23	21
Job Satisfaction	1	7	42	23	27
Family Time	4	5	24	22	45
Leisure	3	3	20	26	48

[a] All figures are shown in percent.

ADVANTAGES AND DISADVANTAGES TO STAGGERED WORK HOURS PROGRAMS

There are many advantages to staggered work hours programs. Unfortunately, there are also some disadvantages involved in the implementation of work schedule changes. This existence of positive and negative consequences is common with any new and innovative idea. In determining if an innovative idea will be successful in practice, all aspects of the idea must be carefully analyzed. All possible benefits and barriers must be weighed against each other to speculate what overall impact the idea will have on those involved. The following discussion of the positive and negative impacts of staggered work hours was derived from a review of the literature to make conclusions and recommendations about the implementation of this type of program.

Advantages

Overall, the most beneficial impact of staggered work hours is the flattening of the peak-period travel demand. This redistribution of demand can dramatically reduce congestion which can lead to a reduction in commuter time, frustration and fuel consumption which go hand-in-hand with traffic congestion. Further, the overall safety and quality of service of freeways could be improved. The redistribution of peak-period travel demand can also have a significant effect on the arrival and departure times of employees at their workplace which can, in turn, reduce total trip time by reducing congestion in parking facilities and by reducing crowding in lobbies and elevators.

There are also many benefits seen by the workplace through the implementation of staggered work hours. Nollen and Martin (11) say that staggered work hours will improve employee morale, satisfaction and motivation and reduce absenteeism. Further, service to customers could be improved through longer hours of operation and the increased telephone contact across time zones.

Finally, the employees could use staggered work hours to their benefit. Staggered work hours afford employees the opportunity to integrate scheduling of work and home responsibilities more smoothly and allow greater flexibility in scheduling non-work activities such as doctor appointments. Staggered work hours could also provide larger blocks of time (either in the morning or evening) to spend with family.

Disadvantages

Despite the benefits of staggered work hours programs, there are some notable barriers to the success of these programs. Staggered work hours may not be complementary to other transportation demand management strategies such as carpooling and transit use. By staggering individual employees' work hours, those already carpooling or using special transit services could be penalized if their carpooling partners' schedules were not changed or if the transit services started or stopped serving before or after they were required to work.

Problems with staggered work hours could also arise in the workplace, especially if the employers have negative attitudes towards the program. Nollen and Martin (11) suggest problems such as difficulty in management or supervisory scheduling and the reduction of inter- and intra-organizational communication. Further, employees may take advantage of the time when the manager or supervisors are not working.

One of the biggest disadvantages of staggered work hours programs is the lack of willing participation by employees. Many employees feel that a change in work schedule will negatively affect their personal lives by disrupting their usual before and after work activities. These activities include dropping off and picking up children from school or daycare, day-to-day errands such as grocery shopping, leisure time and social activities.

Although there are several problems encountered with the implementation of a staggered work hours program, most are not dissoluble. The key to the success of staggered work hours programs is to promote the benefits and find solutions to the barriers.

POSSIBLE SOLUTIONS TO THE BARRIERS OF STAGGERED WORK HOURS

Through careful planning, the barriers to staggered work hours can be avoided. There is a solution to nearly every problem, and these solutions can be found through intensive preparation prior to implementation. Of the above mentioned disadvantages to staggered work hours, most have potential solutions that will improve the situation or eliminate it all together.

For instance, although staggered work hours may not be complementary to carpooling and transit use, efforts can be made during the planning process to ensure that employees using modes other than a single occupancy passenger car will not be penalized by allowing exceptions to employees with special needs. Employees within the organization who are carpooling with one another could be placed on the same work schedules to allow them to continue carpooling. If certain employees are carpooling with others outside of the organization, they could be allowed to remain on their usual work schedule. Considering conflicts of staggered work hours with the use of special transit, the employee could be placed on a schedule that would enable him or her to continue using his or her current form of transit. Moreover, transit agencies could be contacted to negotiate the possible lengthening of service schedules to allow commuters to use the transit services at earlier or later than usual times of the day.

A potential solution to the parking problems encountered by employees who are placed on later schedules would be to manage parking facilities. One such management strategy would be the implementation of reserved parking rather than first-come, first-serve. This approach would allow employees to purchase a parking permit that would ensure them a parking space regardless of their work arrival time.

Solutions to workplace activity disruption also exist. Since supervisors and managers are usually responsible for a particular group of employees, all employees, supervisors and managers working together could be placed on the same work schedules so that communication and scheduling would not be hindered. Further, the scheduling of inter-departmental meetings could be limited to times during the middle of the work day when all employees were present. If problems continue to exist, all employees in the workplace could maintain the same work schedule, and this schedule could be shifted with respect to other organizations' work schedules.

Solutions to personal life interference by staggered work hours are more complicated but not impossible to find. Employee education about the reasons for staggered work hours and the benefits these schedules can produce is the first step to employee willingness to participate. Employee education begins in the workplace through seminars, flyers and pamphlets describing staggered work hours, questionnaires dealing with the advantages of staggered work hours and promotional posters stating the benefits of a staggered work hours programs. Probably the best way to satisfy employees with a mandatory program is by letting them choose their own work schedule change even if it involves a mere 15 minute shift. If employees are allowed some input regarding their schedule change, they will be able to coordinate their work schedules with other aspects of their lives as they please.

As the adage states, "You cannot please all of the people all of the time." Some of the people, however, can be pleased, and the more people who are pleased with a staggered work hours program, the more success it will have. With this success comes the realization by other employees of the benefits, thus convincing more employees of the positive aspects of staggered work hours and gaining more participation. This increased participation will then lead to a successful and beneficial staggered work hours program.

IMPLEMENTATION OF STAGGERED WORK HOURS PROGRAMS

One of the most important factors influencing the success of a staggered work hours program is the implementation of the program. The factors influencing the implementation such as location of the program, the implementation approach, and the attitudes of employers and employees must be carefully considered. The program must be highly coordinated and organized if it is to produce positive results.

Of great importance to the implementation is the location of the project to be implemented. Glen D'Este (6) explains that the entire urban area must be considered, not just the central business district and the adjacent residential areas. This consideration is based on Clark's (10) observation that population density decreases exponentially with distance from the city center. Therefore, D'Este believes that consideration must be given to the correlation between the location of an individual's home and workplace. The correlation between the location of an individual's home and workplace should definitely be considered; however, giving consideration to the entire urban area is not always feasible. In very large urban areas with several central business districts, hundreds of residential areas, and multiple congested freeways, it could be nearly impossible to consider the entire urban area. Because a staggered work hours program in not a CBD type of project only, staggered work hours could first be implemented in any high activity/work center with nearby, well-defined residential areas. The implementation should take place in a staged approach. The program should be concentrated in one central area and expanded over time to encompass more work organizations and work areas. To try and solve the congestion problem by focusing on the entire city seems impractical.

Tannir (5) suggests that there are ideal conditions for the implementation of staggered work hours programs. One condition is that there be a major employer such as the state or federal government. A major employer has a large number of employees, thus providing more participants. A second condition is that the location of the program be in a high density employment center in order that the staggered work hours have an effect on the peak-period traffic demand which is due to the high density employment. A final condition for implementation is that a single agency make all necessary scheduling and moving arrangements by polling individual employees to determine their preferences and arranging the schedules to meet these preferences. This condition is extremely crucial. There needs to be one group of people working for the lead agency that is in charge of the rescheduling. This group can then become familiar with the location of work organizations, residential areas, congested areas, and the employees and their needs. The group can coordinate work schedules based on area transportation needs in order to maximize the reduction in congestion. Further, the group can make special arrangements for employees that are not as flexible when it comes to their work schedule. By allowing one group of individuals to make all of the rescheduling arrangements, the program will be more successful than if the rescheduling of work hours was left up to each individual work organization.

The question of when to implement a staggered work hours program is an important one. Staggered work hours can be successfully implemented in almost any area with a

congestion problem. There are, however, times when staggered work hours may have more of an impact on transportation than others. For instance, during and immediately following an addition to freeway capacity (such as adding a lane or utilizing the shoulders) might be an ideal time to implement a staggered work hours program. The capacity addition will produce an initial reduction in congestion. The implementation of staggered work hours during the capacity addition could help reduce congestion caused by the construction, and continuing staggered work hours after construction will aid in keeping traffic congestion from returning to the level it was before the addition. It will also be easier to convince workers of the need for staggered work hours because of the additional delay they will experience during the construction. Once the workers see the benefits staggered work hours produce during the construction, they will be more willing to continue participating in the program after the freeway construction is complete.

A key to successful implementation of a staggered work hour program lies in convincing employers of the necessity and benefits of staggered work hours and gaining support by the employers for such a program. One way to gain respect from the employers and encourage participation of employees would be for the lead agency to organize an employers' group. The employers' group should be educated that only some of the commuters need to be displaced over two critical times (morning and evening peak) during the day. The employers' group should also be informed of the means needed for successful implementation. The employers would then be drawn into the basic organization of the program and could assist in educating employees of the need for staggered work hours. Further, problems that might arise within the organizations after the implementation of staggered work hours could be overcome through the employers' group. By keeping the lines of communication open between the work organizations and the lead agency, problems can be dealt with immediately and the program will be more successful. Finally, the lead agency can work with the employers' group to help build a medium to encourage participation in the program so as to keep travel patterns constant.

Of the utmost importance is the consideration that must be given to the feelings of the employees. Employees must be given the opportunity to voice their concerns and opinions regarding their work schedule. After all, it is the employees who will going to make the program a success through their participation.

In conclusion, Tannir (5) says, "The success or failure of policy initiation and implementation of work schedule changes lies in the ability of decision makers to assess the positive and negative consequences, to identify risks, to foresee future implications, to weight and balance these consequences, and to decide on the course of action which maximizes the benefits to all concerned."

STAGGERED WORK HOURS--A CASE STUDY

From a review of the literature, the following have been identified as essential locational characteristics if staggered work hours are to be successful in permanently reducing congestion.

1. There must be a recurring congestion problem;

2. The congestion must be linked to well defined areas: work locations and residential areas;

3. The work organizations in the well defined work center must be organized and willing to cooperated in the program; and

4. The location must be one where protection such as ramp metering and freeway-to-freeway metering can be implemented to keep congestion from returning once the staggered work hours program is effectively underway.

With these in mind, in order to demonstrate some of the important steps behind the development of a staggered work hours program, a site in California was chosen. The site chosen was the Simi Valley and the San Fernando Valley, north of Los Angeles, California. This area was chosen because it possesses all of the characteristics listed above. For instance, on a daily basis, Route 118 (also known as the Simi Valley Freeway) is very congested between Simi Valley and San Fernando Valley during the morning and evening peak travel periods. This congestion can be linked to the Simi Valley residential areas and to Warner Center, a high-activity work center in the San Fernando Valley. Further, Warner Center is a highly organized work center which is both transportation concerned and transportation informed. Therefore, employers would be willing to provide employee data to the lead agency and assist in educating employees about the need for staggered work hours. Finally, the location and direction of the Simi Valley Freeway is such that it intersects two main freeways, Interstate 405 and Interstate 5, which feed traffic in and out of the Los Angeles metropolitan area daily. It is possible, then to help protect improved traffic conditions by ramp metering along route 118 and freeway-to-freeway metering at these major freeway interchanges. Thus, the Simi and San Fernando Valleys are excellent candidates for a staggered work hours program.

In the fall of 1988, the California Department of Transportation (Caltrans) conducted a survey of approximately 1800 households in Simi Valley (13). The survey inquired about household transportation practices and characteristics such as the number of drivers and vehicles, commute times and durations, and areas of travel in an effort to resolve the area's traffic problems and to plan for the future.

A brief summary of the Caltrans survey (13) revealed that although there was not a large congestion problem in the Simi Valley, the transportation practices of many of the residents could be creating problems outside of Simi Valley due to those commuting out of the area. Of the households surveyed, 88 percent owned two or more vehicles, and 17

percent owned four or more. In 94 percent of the households, one or more members drove or rode to work every day, and only 12 percent were involved in carpools or vanpools. Of those members that did carpool, only 73 percent did so regularly, and only 46 percent of the carpools were with three or more people.

The answers to the questions regarding commute times were even more revealing and were not surprising. The results are presented in Table 2, and include 88 percent of the commuters surveyed. The results show that the majority of commuters left their households between 7:00 AM and 8:00 AM and began their trips home between 5:00 PM and 6:00 PM which confirms that most of the Simi Valley residents worked the "normal" 8:00 to 5:00 schedule. As shown in Table 3, the majority of residents reported their commute time to be 30 minutes in the morning and the evening; however, more residents reported a longer commute time in the evening than in the morning which could be due to more non-work traffic commuting home from school or end-of-day activities like shopping.

Regarding one-way commuting mileage, 45 percent of the residents reported 10 miles or less, 40 percent between 10 and 20 miles, and 15 percent of the residents had to commute 30 miles or more to work. The work regions reported encompassed a large portion of the Los Angeles metropolitan area as well as the San Fernando Valley and surrounding area. Figure 7 shows the directional percentages of work travel by Simi Valley residents in and around Simi Valley. Fifty-five percent of the residents reported that they used Route 118 east to commute to work in or beyond Simi Valley, 13 percent reported using Route 118 west, and 32 percent of the residents used local streets to get to and from work.

Table 2. Morning and evening commute times for Simi Valley Residents (13)

Morning Commute Time	**Percent of Residents**
Between 6:00 AM and 7:00 AM	23
Between 7:00 AM and 8:00 AM	55
Between 8:00 AM and 9:00 AM	10
Evening Commute Time	
Between 2:00 PM and 3:00 PM	10
Between 3:00 PM and 4:00 PM	16
Between 4:00 PM and 5:00 PM	24
Between 5:00 PM and 6:00 PM	38

Table 3. Morning and evening commute durations experienced by Simi Valley Residents (13)

Morning Commute Duration	Percent of Residents
15 minutes	20
30 minutes	33
45 minutes	11
1 hour	16
Evening Commute Duration	
15 minutes	17
30 minutes	30
45 minutes	11
1 hour	22

Knowing that a large percent of Simi Valley residents use Route 118 to commute to and from work, traffic volumes were obtained from Caltrans. The hourly traffic volumes were averaged for a Monday through Friday work-week in mid-July, 1992, and the traffic volume profile is shown in Figure 8. The traffic profile shows the morning and evening peaks in travel demand caused by the 8:00 AM to 5:00 PM work hours in and around the Simi Valley. The volumes received from Caltrans were obtained west of Simi Valley near the intersection of Route 118 and Spring Road. (It should be noted that although it was discovered that the Simi Valley Freeway is not congested in this area, the volumes shown are extremely low for a six-lane freeway and should be questioned. The volumes do, however, represent the twice-a-day peaking of travel demand of Simi Valley residents.) Due to the location of the control station, the data are only representative of the travel demand west in the morning and east in the evening, and this portion of Route 118 is not congested. The travel demand of Simi Valley residents represented in Figure 8 is, however, creating problems as it was later confirmed that Route 118 east of Simi Valley is very congested for approximately two hours in the morning and two hours in the evening. This congestion stretches from the top of Santa Susana Pass to San Fernando Valley and is due in part to the 55 percent of Simi Valley residents using Route 118 to travel to and from work. Although no actual volume counts are available for this section of Route 118, all necessary information is available to develop the flow profiles for the AM and PM peak periods. For example, assuming the capacity of Route 118 to be approximately 2000 passenger cars per hour per lane and knowing that it is a six-lane freeway, the freeway can serve no more than 6000 passenger cars per hour in one direction. Further, no freeway can operate at capacity conditions once there has been a breakdown in the flow conditions. From this knowledge, Figure 9 was developed to represent the eastbound AM peak on Route 118 between Topanga Canyon Boulevard and Interstate 405 and the westbound PM peak on Route 118 between Interstate 405 and Topanga Canyon Boulevard, respectively. Thus, due to the

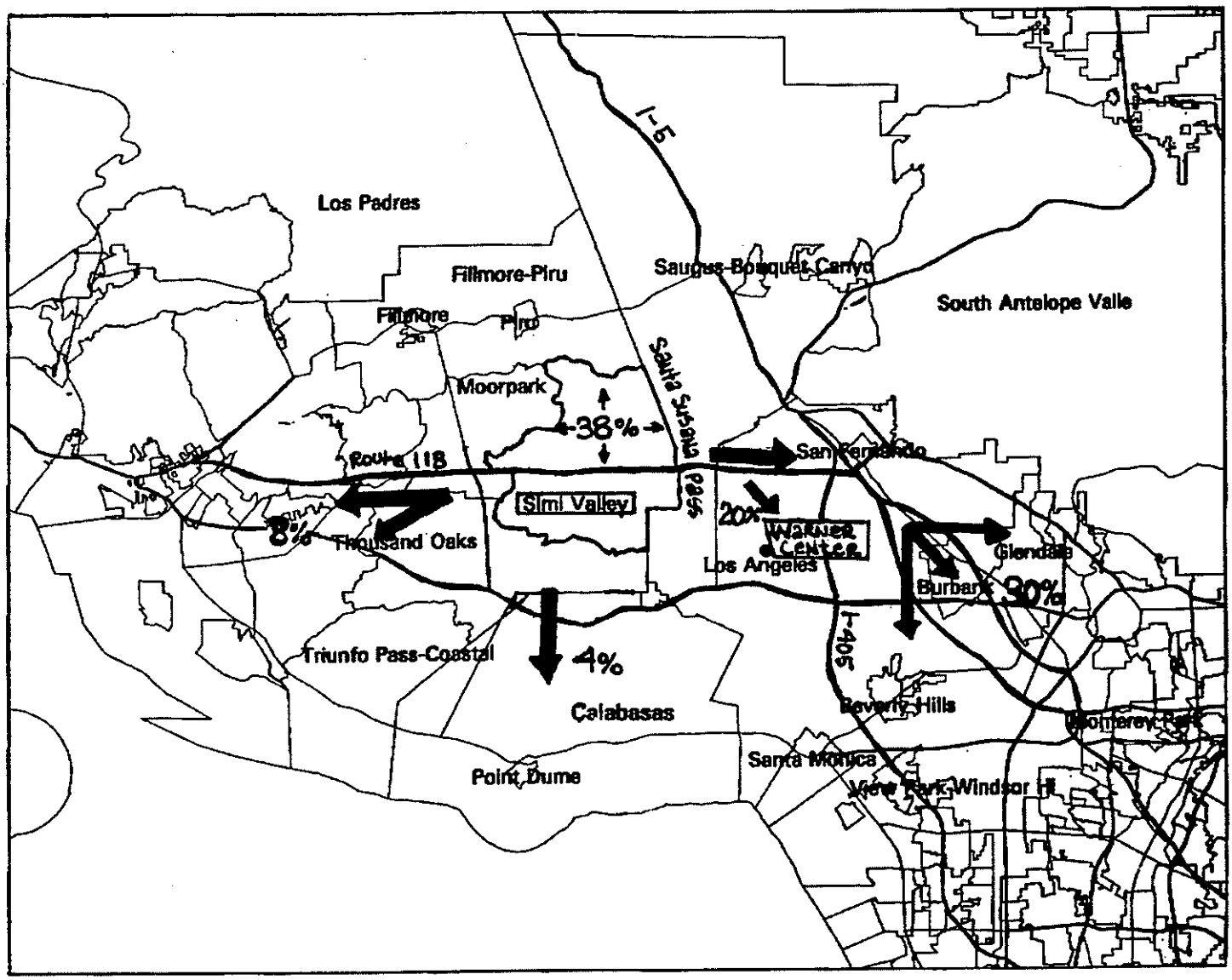

Figure 7. Directional percentages of work travel by Simi Valley residents in and around Simi Valley.

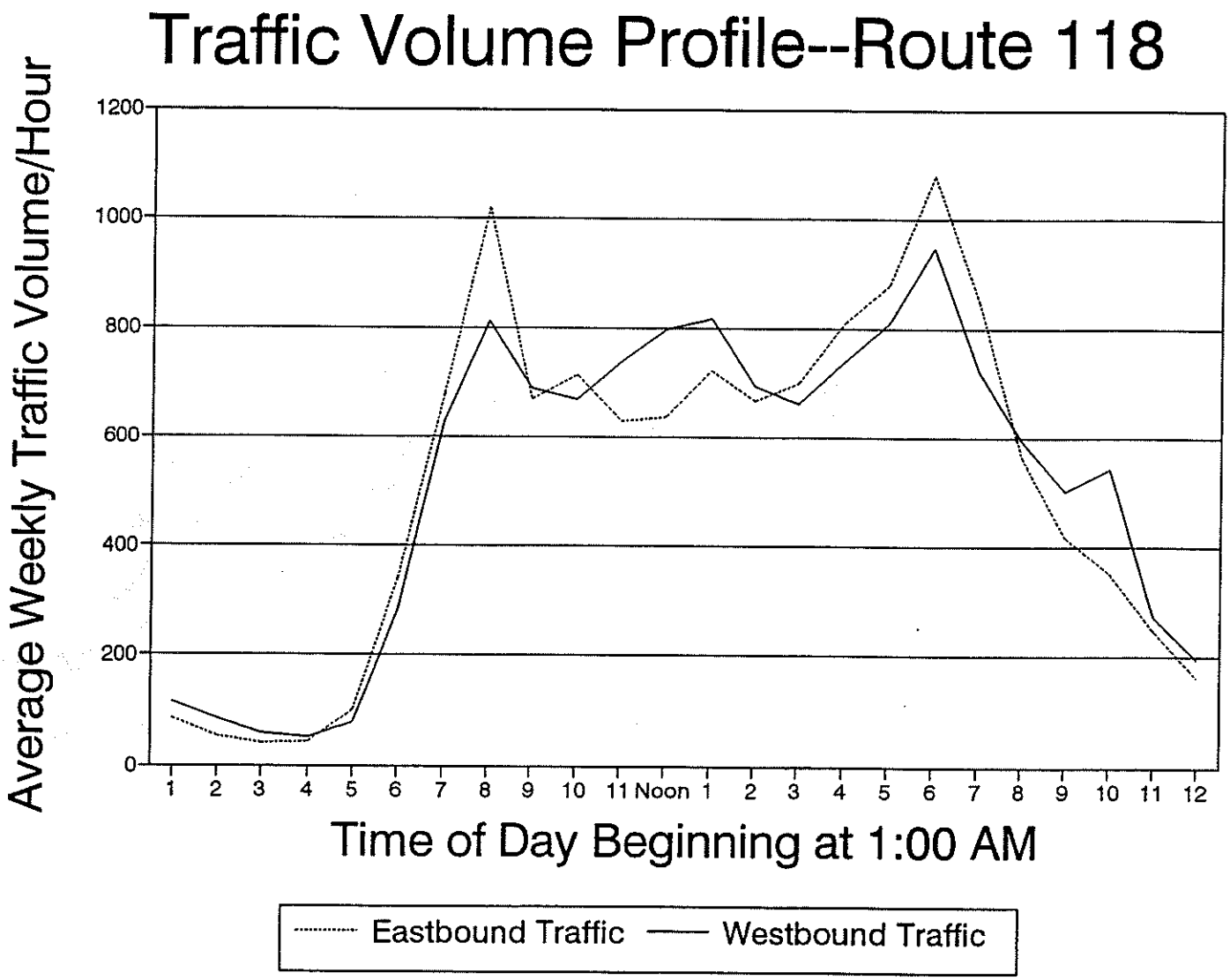

Figure 8. Averaged work-week traffic flow profile for Route 118 west of Simi Valley.

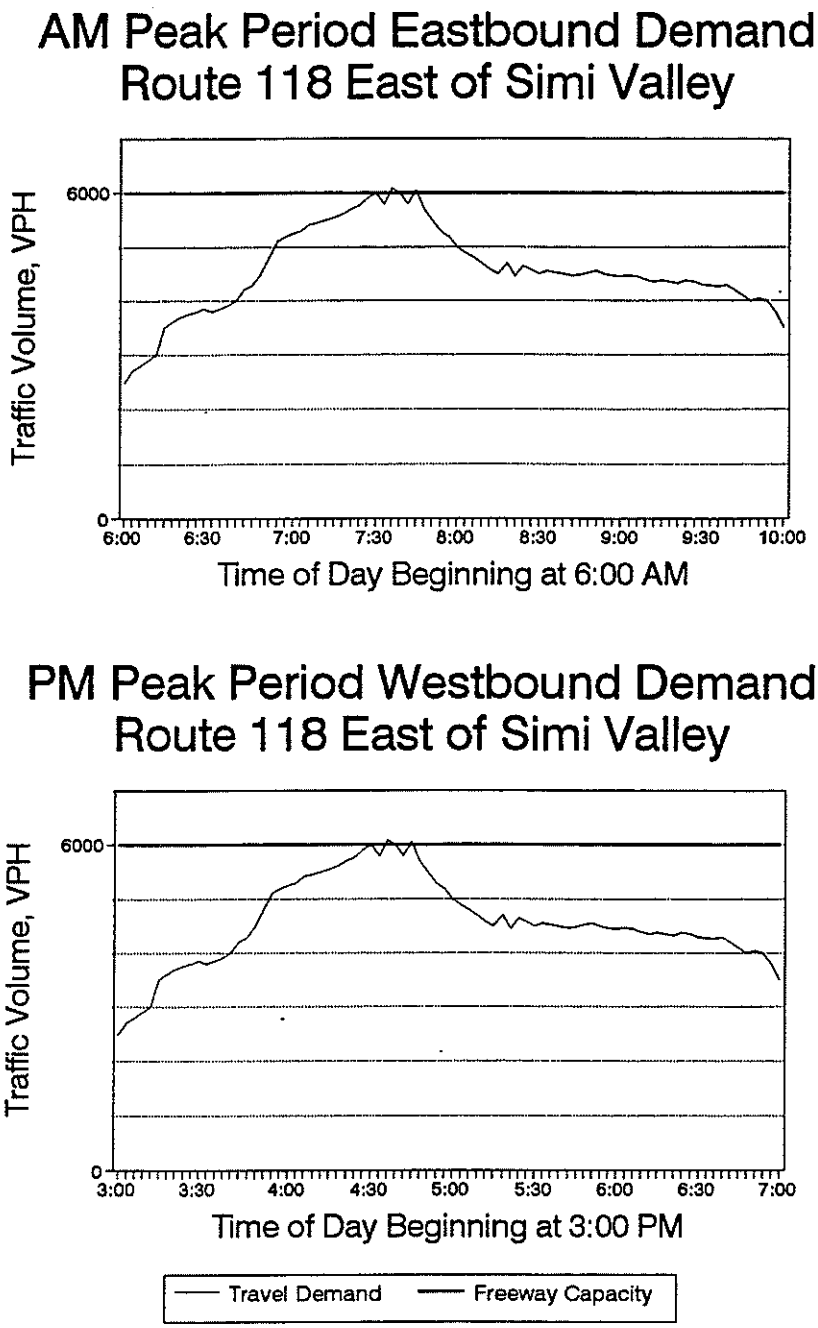

Figure 9. Eastbound AM peak period travel demand and westbound PM peak period travel demand profiles.

location of Route 118 and the travel habits and patterns of Simi Valley residents, the congestion along Route 118 east of Simi Valley could be reduced by a staggered work hours program.

The origin and solution to the congestion problem east of Simi Valley have now been defined. In order to begin the planning process for a staggered work hours plan for the Simi Valley area, the needs of the program and its implementation must be defined. From a list of implementation steps recommended by the Transportation Research Board (3), the following procedure is proposed for the implementation of a staggered work hours program in Simi Valley and San Fernando Valley.

The first step is to define a lead agency. Possible candidates would be the California Department of Transportation, a city within Simi Valley, or a city within San Fernando Valley. Caltrans, however, would be the best choice as it could eventually expand the program to encompass a wider area of Los Angeles.

Once the lead agency is established, commitment from public and private organizations within Simi Valley and San Fernando Valley needs to be obtained. The most successful way to gain this commitment would be for the lead agency to form an employers' group. This group could meet to voice their opinions and concerns prior to the implementation of the program. Then, during the program, the group could continue meeting to discuss problems brought about by the program and ideas dealing with workplace activity organization or the education of employees about the program.

Next, high-priority employment locations should be identified. Because about 20 percent of Simi Valley residents commute to the San Fernando Valley, a large portion of them to Warner Center, companies within Warner Center should be contacted and notified of their needed participation in the proposed program. If not already involved, the employers should become active in the employers' group, and employees should begin attending educational seminars regarding staggered work hours.

Feasibility studies should then be conducted to determine if staggered work hours will have a positive effect on the transportation between Simi Valley and San Fernando Valley.

The fifth step would be to conduct work schedule and transportation surveys of employees. This step should be completed by a defined group of individuals within the lead agency. To begin, the group needs to determine, via the employer, from where each of the employees in each of the companies is commuting and what route is taken to and from work. Information should be obtained regarding residents of other areas who work in Warner Center and use Route 118 to commute to and from work. This could help in further reducing congestion along the freeway. It does appear (from information obtained from Caltrans) that many of the non-Simi Valley residents who work in Simi Valley live nearby and travel Route 118 to and from work. To reduce congestion along Route 118 even further, Simi Valley residents who work in areas beyond San Fernando Valley and use Route 118 through the valley (and those whose employment agency is not involved in the

program) should be encouraged through public education to participate in flexible work hours if they are allowed by their employer. Also, the lead agency should contact other employment centers beyond San Fernando Valley to encourage participation.

Next, the defined lead agency group should become familiar with the needs of the employees. Provisions should be made so that workers using transit or carpooling will be able to continue this practice after the schedule change. Further, the group should coordinate schedules for groups of employees within an organization who work closely together in order to reduce the conflicts that might arise in the workplace due to the rescheduling of work hours; or all employees within an organization (especially small companies) could be allowed to maintain the same work hours which could then be staggered with respect to other work organizations' schedules.

Finally, the program should be implemented in a staged approach beginning with only a few companies. Implementation assistance to the companies by the lead agency should be provided to make the transition as smooth as possible. The impacts of the staggered work hours program should be evaluated during each stage of implementation in order to assess the overall effects of the program. Impacts should be evaluated by collecting travel time data along with questionnaires to employers and employees. Before each new stage of the program, details should be refined as needed to encourage positive benefits during the next stage of the project. The hope is that once a program has been implemented, the benefits produced will become greater as the program is expanded. Eventually, employees will build their lifestyles around the new staggered work hours that make commuting to and from work a more pleasant experience.

CONCLUSIONS

"Peak hour traffic management is not the whole answer to traffic problems, but it certainly is one of the tools that we have to help us deal with road and highway problems," says Granville Bowman, director of the San Diego County Department of Public Works (14). Peak hour travel demand is due largely to the existing 8:00 AM to 5:00 PM work hours. Therefore, a traffic management technique that concentrates on trips to and from work could help reduce congestion. Staggered work hours have been used as a traffic management technique to reduce congestion; and studies have shown that staggered work hours can have a positive effect on transportation by spreading the peak period travel demand over a longer time period. This "spreading" of the peak period traffic demand results not only in reduced work travel time, but in improved quality and safety of highway service.

Staggered work hours greatly redistribute the peak period work arrival and departure times which reduces congestion in parking facilities, elevators, lobbies, etc., thereby further reducing travel time to and from work. Staggered work hours tend to have more positive than negative impacts on transit and private ridership; however, work schedule changes may cause a reduction in the use of these modes of transportation if the changes are not carefully implemented (7,8). Although the success of a staggered work hours programs may appear to be easily obtained, it is highly dependent on the number of participants and the distance of the congested freeway from the employment center, thus, extensive planning is needed prior to the implementation of a work schedule change. Moreover, the success of staggered work hours is hindered by commutes not participating in the program and commuters making non-work trips.

Staggered work hours can have both positive and negative effects on the workplace; however, the positive effects are expected to outweigh the negative effects. By coordinating group's of employees work schedules who work closely together or allowing employees within a work organization to maintain common work hours, possible conflicts with communication and scheduling will be reduced. Further, through careful planning of work activities before and during the schedule change, the negative impacts can be reduced or even eliminated.

Staggered work hours can also have positive and negative effects on the employee. It has been shown, however, that most employees have neutral or positive attitudes toward staggered work hours. It is expected that once the employee sees the benefits that a work schedule change can produce, they will be willing to participate and will help recruit other participants. This networking will contribute to the success of the program.

The key to the success of staggered work hours lies in the implementation of the program. Without comprehensive planning and organization prior to implementation, problems can and most likely will arise once the program has begun. Poor coordination and lack of prior comprehensive planning can lead to failure of a staggered work hours program.

The benefits gained through staggered work hours programs are even greater when compared to other congestion management techniques such as transit services and high-occupancy vehicle lanes as there is no construction required. Staggered work hours are a low cost solution to a potentially high cost problem. If something goes terribly wrong at any stage of the program, it can be aborted immediately with little or no cost to anyone involved. Therefore, a staggered work hours program would be a perfect pilot project for any well defined urban area section with a congestion problem.

RECOMMENDATIONS

In order to reduce peak-period congestion, staggered work hours programs should be developed and implemented; however, prior to implementation, comprehensive planning should take place in order to promote the success of the program. A lead agency, preferably a governmental agency, needs to take responsibility for the implementation and success of work schedule changes.

Staggered work hours should be considered in medium to large urban areas with one or more well defined work/activity centers and well defined surrounding residential areas that are connected by freeways with severe recurring congestion. Staggered work hours should be implemented in a multi-staged approach beginning with work schedule changes of those workplaces nearest the congested freeway and those employees living closest to the work center. For locations with long peak periods of more than two hours (usually very large urban areas), the work schedules need to encompass a wide range of work starting and stopping times in order to reduce the long, flat peak produced by the extensive travel demand.

In order to combat problems with latent demand, especially after an addition to freeway capacity, staggered work hours could be implemented during the construction in an attempt to reduce congestion during construction. After construction is complete, staggered work hours should be continued so as to keep congestion to returning to the level it was before the capacity addition. Further, once staggered work hours have been implemented, other controls such as ramp metering and freeway-to-freeway metering should be considered to deal with non-participants and non-work trips which reduce the positive effects of staggered work hours.

The lead agency should organize an employers' group to encourage participation and to help target the employees and their needs. The employers' group can assist in making the staggered work hours a success by communicating the needs of the work organizations to the lead agency, thus expediting any changes that are needed in the program.

Staggered work hours are not the only form of work schedule changes. Other types of work schedules such as variable work hours and compressed work weeks should also be considered, as the mandatory nature of staggered work hours has proven to be a disadvantage. Some employees may have different preferences when it comes to their work schedules and may be willing to participate in the mandatory program it they are allowed to choose their schedule. Thus a mandatory program can be made a more flexible program. Once employees see the positive effects of staggered work hours, they may never again want to return to the standard 8:00 AM to 5:00 PM work schedule.

Recommended Area for Implementation in Houston, Texas

The city of Houston was considered for a location that might benefit from a staggered work hours program. Houston is a very large city which contains many high activity centers and several major freeways passing through the city. To begin, it would not

be practical to implement a program that included the Houston downtown area because the entire city and all congested freeways would have to be considered. Therefore, one area of Houston was selected as a candidate for a staggered work hours program. The area chosen is located in the southwest part of the city. The freeway through this area is the Southwest Freeway, which has been very congested in the past, especially near the interchange at Interstate 610. The Southwest Freeway, however, has recently been expanded from a six-lane facility to an eight-lane (on the average) facility with a reversible high-occupancy vehicle lane. Temporarily, congestion has been reduced; however due to this reduction, latent travel demand may be attracted in the near future. A staggered work hours program along with connector metering at I-610 and ramp metering along the Southwest Freeway could help keep the congestion level from returning to the level it was before the expansion.

The Southwest Freeway is not the only reason that this area is a candidate location for staggered work hours. There are several high-activity work centers located near the Southwest Freeway such as Westwood Mall, Sharpstown Mall, Transco Tower/Windsor Center, The Galleria, Greenway Plaza, and the Texas Medical Center. Further there are a number of residential areas in southwest Houston near or along the Southwest Freeway including Sugar Land, Missouri City, Bellaire, Southmeadow, Glenshire, Sharpstown and West University Place. It is expected that many of the residents in these areas use the Southwest Freeway to commute to and from work.

Thus, southwest Houston would be an excellent location in which to begin planning the implementation of a staged staggered work hours program.

ACKNOWLEDGEMENTS

This report was prepared for CVEN 689, *Advanced Surface Transportation Systems,* at Texas A&M University. The author would like to express her appreciation to Mr. Dave Roper of Roper and Associates, Inc. for his direction and encouragement over the summer. The author would also like to acknowledge Mr. Don Capelle, Mr Joe. McDermott, Mr. Walter Kraft, Mr. Ed Rowe, and Mr. Gary Trietsch for their time and expertise devoted during this course. A special thanks is extended to Dr. Conrad Dudek and Sandra Mantey for their comments and assistance throughout this project.

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