JALA International, Inc.

City of Los Angeles Telecommuting Project

Final Report

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Note that JALA changed its name from JALA Associates, Inc. to JALA International, Inc. in mid-1992 to more accurately reflect the scope of its activities.

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History

The City of Los Angeles Telecommuting Project started in early 1989 with a planning project. The project culminated in a formal plan that was submitted to the Mayor and the City Council in August, 1989. The plan recommended implementation of a formal test project that was to include 18 months of active telecommuting and involve 250 telecommuters and a comparable number of members of a control group. The Mayor subsequently requested that the number of telecommuters be raised to 500.

The implementation portion of the project began in April, 1990, with a series of briefings on the project plans to senior City executives. The remainder of 1990 was spent in briefing prospective participants in the project and in selecting the initial set of participants for training.

By the end of 1990, 426 City employees had applied or had been identified by their supervisors for possible inclusion in the project. As part of the selection process, both prospective telecommuters and their immediate supervisors are required to complete background questionnaires. By 1991, 298 employees (and their supervisors) had completed all of the necessary forms. Of these, 279 were recommended by JALA Associates for training and subsequent telecommuting. Although JALA Associates recommended specific individuals, all final selection decisions were made by the management of the participating departments.

Training of the telecommuters and their telemanagers began in January, 1991 and continued through March, 1992, by which time 541 telecommuters had been recommended for training by JALA and 441 telecommuters had been trained, together with their supervisors. Active telecommuting was to begin shortly after the initial training sessions. The rule is

that, once a telecommuter and his/her direct supervisor have attended the training sessions and have signed an agreement on their respective roles and performance expectations, they may begin telecommuting. A few of the participants had already been "guerrilla" telecommuters before they received formal training but most were neophytes. Of the 441 telecommuters trained, only 242 had returned written telecommuting agreements to the project office by December 1992. As of March, 1993, 203 telecommuters were still active.

The formal, data collection portion of the project was completed for most of the telecommuters by July 1, 1992. The data collection period was extended to November 30 for the dozen telecommuters who were trained after January 1, 1992. Therefore, the lengths of individual telecommuting experience range from a few months to more than two years.

Goals and Objectives

The following material, in a smaller typeface, is taken directly from the project plan as submitted to the Mayor and Council.

Telecommuting has become steadily more desirable and practical in the past two decades as the number of information workers has increased and as computer and telecommunications technologies have continued their spectacular advances.

There are a number of reasons to actively explore telecommuting at this time. Here are a few:

- *Air Pollution. Automobile commuting constitutes the major non-stationary contributor to air pollution. The Southern California Air Quality Management District's Regulation XV requires medium to large employers to quickly take positive steps to reduce commuting. The Air Quality Management Plan calls for a 20% reduction in commuting via telecommuting by 2010.*

- *Cost Effectiveness. Experience with telecommuting in the private sector and by the State of California has shown significant and lasting increases in the productivity of telecommuters — averaging from 5% to 20%, decreased rates of turnover, space and energy savings and other net cost reductions.*

- *Traffic Congestion. It is reaching unmanageable levels in the downtown area — and in many other Los Angeles locales. It is slowing work and frustrating commuters. Just in Los Angeles millions of hours of potential productivity — and billions of dollars in economic output — are being lost annually from congestion.*

- *Energy Dependency. Commuting continues to account for almost half of the automobile transportation energy use in California, making us increasingly susceptible to fuel shortages and supply interruptions.*

- *Office Space. The City is running low on affordable office space in central Los Angeles. Costs of parking space are rising as well.*

- *Information Technology. Computers are showing up on more and more desks of City workers. Computers connected to telephone lines provide a significant opportunity to make many forms of information work partially "location independent" and ideal for telecommuting.*

- *Attracting/Retaining Personnel. Telecommuting as a work option has been found to be an effective tool for helping to attract and retain qualified personnel in a competitive market.*

- *Access to Jobs. The mobility disadvantaged, whether it's a result of physical impairments, inadequate transportation, or other factors, can have easier access to jobs via telecommuting.*

The objective of the project outlined here is to test those claims with a group of telecommuting City employees.

According to the City's consultant, preliminary cost benefit forecasts point to substantial advantages of telecommuting. For example, if the performance of the telecommuters in the pilot project just equals current experience with the State's project, the costs of the project will be recovered in about one year. If the City telecommuters' performance approaches the higher end of private sector experience to date, the pay-back period could shrink to a few months. After that period, hard economic benefits could significantly outweigh operating costs, unlike other approaches to traffic congestion reduction.

The pilot project has five phases: orientation, participant selection, training, active telecommuting and evaluation. In the orientation phase the prospective managers and telecommuters will be briefed on the project. During the participant selection phase the specific participating departments and telecommuters, and the sites at which they will work will be selected. Next, both managers and telecommuters will be trained and active telecommuting will begin. Finally, the results will be evaluated to answer the questions: should telecommuting be expanded beyond the pilot project; and, if so, in what forms?

Although some details of the project design have changed during its course, the overall goals and objectives have remained the same.

Results

Each of the goals enumerated above has been met by the telecommuters in the project.

- **Numbers**. Our analysis suggests that almost 16,000 City of Los Angeles employees could telecommute at least part time, either from home or from a satellite telework center closer to home that their primary office.
- **Air Pollution and Traffic Congestion**. Automobile use by the telecommuters has been reduced in direct proportion to the extent of their telecommuting. The result is both reduced air pollution and reduced traffic congestion — their cars are off the rush hour roads while they are telecommuting. The average City telecommuter reduces annual air pollution production by 276 pounds of carbon monoxide and 17 pounds of NO_X. If all of the 16,000 potential City telecommuters were telecommuting from home at the rates we think are feasible, annual air

pollution production would be reduced by 6.2 million pounds of carbon monoxide, 1.2 million pounds of unburned hydrocarbons, 380,000 pounds of NO_X, and 26,000 pounds of particulates.
A critical factor is the effect of this on Average Vehicle Ridership (AVR), as monitored by the South Coast Air Quality management District. If all the potential City telecommuters were to telecommute from home, averaging 1.4 days per week, the Civic Center AVR goal of 1.75 would be met without further changes in ridesharing or compressed work schedules. Our analysis indicates that this is feasible.

- **Cost Effectiveness**. The effectiveness of the telecommuters has increased by an average of 12.5% — according to their direct supervisors — relative to their non-telecommuting co-workers. Individual effectiveness increases range from no change to 100%. At this point, the annual economic impact of this improvement alone is about $6,100 per telecommuter. Other annual benefits can add $2,000 per telecommuter, for a total of about $8,000 each. If all the potential City telecommuters were telecommuting, the annual net benefits could be as high as $140 million, at least $80 million of which would be in individual effectiveness improvements.
- **Energy Dependency**. The average telecommuter currently saves energy to the tune of about 4000 kilowatt-hours per year, largely from reduced fuel consumption. Not only is the energy saved, the saving accrues to our most important and vulnerable energy resource — petroleum. If all the potential telecommuters were telecommuting 1.4 days per week, the annual energy savings would be about 60 million kilowatt-hours (the equivalent of 1.6 million gallons of gasoline).
- **Office Space**. We estimate that the demand for office and parking space could be reduced by as much as 30% for City telecommuters.
- **Information Technology**. Personal computers are becoming vital tools for almost all City information workers. About 73% of City telecommuters now own their own personal computers and use them for telecommuting. The average telecommuter personally invested $1400 in telecommuting-related technology in the past year. Some eligible City employees were kept out of the project because they needed personal computers to telecommute but did not have them at home.
- **Retaining Personnel**. Telecommuting is important in retaining the skills of trained City employees; 18% of the telecommuters said the ability to telecommute was a moderate to decisive influence on their decision to stay with the City rather than take a job elsewhere. We estimate the

1992 benefit of that aspect of telecommuting to be at least $200,000.
Related to this — and to the effectiveness improvements — is the fact that telecommuting clearly enhances the quality of life of the telecommuters.

- **Access to Jobs**. Because of the hiring freeze during the project, we were unable to test the ability of telecommuting to create jobs for the mobility handicapped. However, telecommuting clearly made life easier for those telecommuters who had mobility impairments.
- **Modes of telecommuting**. The figures above are based primarily on the assumption that the telecommuters would be working from home. In reality, we do not expect that all telecommuters would want — or be able — to work from home. A significant number, possibly as much as 60%, would work from satellite offices closer to their homes than their primary offices. These satellite offices could be either City facilities or facilities owned/operated by other public agencies. We would expect that the number of telecommuting days for satellite centers would be higher than those for home-based telecommuting so that the net energy and air pollution impacts would be comparable to those stated above, even though many telecommuters might drive to the satellite offices.

Recommendations

The success of the project leads to the following recommendations.

Continue Existing Telecommuting. Of the 20 departments active in the project, only 2 (employing a total of 5 telecommuters) discontinued telecommuting after the nominal end of the active phase. The rest are continuing telecommuting, for those employees who were involved in the project, until a final decision is made by the Mayor and Council. We recommend that all the present or formerly active telecommuters be allowed to continue/resume telecommuting until that decision is made.

Integrate Transportation Demand Management Strategies. Telecommuting has proven itself to be an effective rideshare strategy. Promotion and expansion of telecommuting should be a formal part of an integrated strategy for managing the use of transportation by City employees.

Create Specific Incentives and Disincentives. Although the project has been successful, it is abundantly clear that there is still significant resistance to telecommuting — not to mention downright hostility — on the part of many City managers. A system of incentives (recognition, factors in promotion/salary decisions, etc.) and disincentives (such as minimum telecommuting quotas) should be devised to overcome that resistance.

Expand Telecommuting. The results of the project clearly indicate that the use of telecommuting should be expanded. Our analysis suggests that at least 15,934 City employees — one-third of the City's permanent staff — could successfully telecommute. Since a possibly large portion of them would be best suited for telecommuting from a satellite office, it is important to begin further testing of satellite operations as soon as possible.

Increase and Expand Training. It is also clear that training in the management methods of successful telecommuting is important to telecommuting's success. Both initial, pre-telecommuting training and follow-up reinforcement are called for. All of the City's telecommuters and telemanagers should receive training.

Improve Access to Information Technology. There is no question that access to personal computers is a major factor in improving effectiveness of City information workers, whether or not they are telecommuters. A number of telecommuting-trained City employees were prevented from participating in the project because they didn't have personal computers at home or were unable to get access to the City's mainframe computer. Our focus group sessions and personal interviews indicated many cases where City employees have invested their own funds in computer equipment that is superior in performance to that in their principal office. It appears that the City is incurring major opportunity costs because of the freeze on computer equipment. It is extremely important that this issue be resolved soon.

Develop TeleService Program. The City has already developed regional City Halls in San Pedro, Van Nuys and West Los Angeles. Telecommuting could be used to further distribute City services all over the City. This may be of particular importance in areas affected by the recent riots. Mini- or micro-City Halls could be developed, staffed by telecommuters living locally, to provide most City services to local residents.

Provide Area-wide Leadership. There are many ways in which the City can show leadership in Southern California. For example, the City should publicize the results of the telecommuting project to other cities and to area businesses. Zoning ordinances should be rewritten to encourage telecommuting (while discouraging potential urban sprawl made possible by telecommuting). The City should cooperate with other Cities and public agencies to share facilities for telecommuters so that public sector employees all over the region can begin telecommuting from satellite offices near their homes.

Action Plan

As a means of implementing these recommendations, the following specific steps are proposed.

Telecommuting Implementation Group. The first step in the expansion process is the appointment by the Mayor of a proactive Telecommuting Implementation Group (TIG) whose primary task is to ***motivate*** **and coordinate** the expansion process. Members of the TIG should be proactive senior managers from every department of the City that has, or is likely to have, active telecommuters. The TIG should also include representatives from all of the affected unions. The Chairperson of the group should be someone who is directly concerned, because of the nature of his/her job, with traffic reduction or with productivity improvement. We suggest that the City Rideshare Program Administrator accept this responsibility. The first action item for the TIG should be the development and coordination of uniform telecommuting guidelines.

Telecommuting Expansion Project. The Telecommuting Expansion Project is a larger scale version of the Pilot Project. The process is quite similar.

- First, the Mayor and Council should address the issues of the necessary policies and infrastructure: personnel work site assignment rules; administrative procedures; telecommunications, computer and satellite office requirements.
- Second, a new series of briefings and/or informal meetings with department General Managers and senior managers should be made, focusing on the key policy issues and the specific experiences in their own departments. No department should be left out of this process. Each General Manager should be asked to develop a telecommuting implementation plan and schedule. The plan should include technology, training and space needs as well as emergency preparedness issues.
- Third, a series of familiarization briefings to mid-level managers and supervisors should be held, on a department by department basis.
- Fourth, all potential telecommuters should be given briefings on telecommuting, including clear descriptions of the work options and responsibilities of telecommuters, and should be given an opportunity to volunteer to become telecommuters.
- Fifth, the volunteers and their supervisors should go through a formal selection process that serves as a means for identifying possible problems with telecommuting.
- Sixth, the selected telecommuters and telemanagers should be given formal training in telecommuting management techniques.

Steps three through six need not be completed for all of the telecommuters at once. A better strategy for large departments

may be to implement telecommuting on a division by division basis, or even in smaller increments, as dictated by operational considerations. The overall schedule may be dictated by the requirements of the SCAQMD.

TeleService Pilot Project. Given the severe constraints on the City's budget, it is not likely that a series of conventional local City Halls will be built any time soon. However, it seems entirely feasible to do "reverse telecommuting:" to use existing City facilities that are turned into multi-purpose operations for disseminating a variety of information and completing routine City-citizen transactions. Applicants would be able to go to a local City facility and be in contact with the required experts regardless of the actual location of the experts.

As is the case with telecommuting, the benefits derived from a TeleService program may significantly exceed operating costs. However, until a more thorough analysis is made of the opportunities, issues, potential benefits and costs, it is not possible to gauge the total impact. Therefore, we propose that a pilot TeleService project be planned and developed to explore the opportunity.

Interagency Facilities Sharing Project. Sponsored by the Institute for Local Self Government,[1] a project is currently under way to develop and demonstrate office space sharing arrangements among local governments. The central concept of the project is that local governments can develop satellite office telecommuting arrangements without necessarily leasing new office space elsewhere. A City of Los Angeles employee living in, say, Rialto could telecommute part time from the Rialto Civic Center rather than commuting to downtown Los Angeles — and vice versa. The City should participate in this or a similar project. Our analysis of the residence and work locations of a sample of 580 prospective City telecommuters indicates that only 4 now work at the City (or other public agency) facility nearest their homes.

[1]The ILSG is a non-profit, non-partisan reserach and education organization affiliated with the League of California Cities. Its mission is to promote and strengthen local self government.

Part 1: Project Description

Introduction and Overview

The City of Los Angeles Telecommuting Pilot Project began with a planning project in 1989. The project culminated in a formal plan that was submitted to the Mayor and the City Council in August, 1989. The plan recommended implementation of a formal test project that was to include 18 months of active telecommuting and include 250 telecommuters and a comparable number of members of a control group. The Mayor subsequently requested that the number of telecommuters be raised to 500.

Participant Selection

The implementation portion of the project began in April, 1990, with a series of briefings on the project plans to senior City executives. The remainder of 1990 was spent in briefing prospective participants in the project and in selecting the initial set of participants for training.

By the end of 1990, 426 City employees had applied or had been identified by their supervisors for possible inclusion in the project. As part of the selection process, both prospective telecommuters and their immediate supervisors were required to complete background questionnaires. Of the total number of people identified in 1990, 298 (and their supervisors) had completed all of the necessary forms. Of these, 279 were recommended by JALA Associates for training and subsequent telecommuting. Although JALA recommended specific individuals, final selection decisions were made by the management of the participating departments. Eligibility to join the project was held open through March, 1992, in order to accommodate departments that were slow in making acceptance decisions.

Training

Training of the telecommuters and their telemanagers began in January, 1991 and continued through March,

1992, by which time 540 telecommuters had been recommended for training by JALA and 441 telecommuters had been trained, together with their supervisors. Active telecommuting generally began shortly after the initial training sessions. The rule proposed by the consultant is that, once a telecommuter and his/her direct supervisor have attended the training sessions and have signed an agreement on their respective roles and performance expectations, they may begin telecommuting. A few of the participants had already been "guerrilla" telecommuters before they received formal training but most were neophytes. Some trainees' telecommuting was postponed because of problems in securing equipment necessary to make their telecommuting fully effective. Of the 441 telecommuters trained, only 242 had returned written telecommuting agreements to the project office by December, 1992. The agreements indicated that they were officially sanctioned by their departments as telecommuters.

The Fire Department withdrew from the project, at the order of the Chief, immediately after Department personnel were trained. The reason given for the withdrawal was that the Department could not afford the cost of the projects, although at no time was the Department told it would be liable for any costs related to the project other than the time required by participants in completing survey forms.

Evaluation

Evaluation of the project began with the selection phase and continued through 1992. Details of the evaluation philosophy and process are given in Appendix 2.

The formal, data-taking portion of the project was scheduled for completion as of June 30, 1992. However, because of the late entry of a number of telecommuters, data collection continued through November, 1992 for the 39 telecommuters who were trained after January 1, 1992. This additional time was to ensure the inclusion of meaningful data from their telecommuting experience in the final evaluation.

Participation

Twenty-two City departments have been actively involved in the project at some point. The final status is shown in Table 1. The table shows, for each department, the total number of:

- applicants of all sorts;
- completed sets of applications;
- positive recommendations, by JALA Associates, for some form of telecommuting;
- telecommuters actually trained;

- telecommuting agreements signed and returned to the Project Manager
- baseline and mid-term evaluation questionnaires returned.

Table 1: Participating Departments

Department	Total Applications	Forms Completed	JALA Approved	TCers Trained	Agreements Received	Baseline Evaluation	Midterm Evaluation	Final Evaluation
Building & Safety	44	37	37	41	21	11	16	13
City Attorney	60	30	29	22	14	14	21	15
City Clerk	44	38	35	0	0	0	27	16
City Planning	57	48	45	28	22	15	27	16
Community Development	10	8	8	9	5	3	5	5
Controller	13	11	9	11	11	2	10	7
Employee Relations Board	3	3	3	3	3	0	0	0
Environmental Affairs	3	1	2	3	3	0	1	1
Fire	37	30	30	11	1	0	6	0
General Services	10	10	10	10	5	5	7	1
Harbor	5	5	5	5	3	3	4	2
Information Services	100	65	55	48	21	24	43	34
Library	42	21	21	29	3	0	18	10
Mayor's Office	2	0	0	0	0	0	0	0
Pensions	9	9	9	7	7	4	6	4
Personnel	24	22	21	14	12	9	15	14
Police	208	141	140	115	82	67	95	54
Public Works	23	21	21	15	9	9	15	12
Recreation and Parks	23	22	19	8	8	7	18	11
Telecommunications	7	4	4	5	3	1	2	2
Transportation	22	21	21	12	9	6	14	7
Water & Power	49	23	17	45	0	0	12	11
TOTALS	**795**	**570**	**541**	**441**	**242**	**180**	**362**	**235**

Note that some of these departments did not actively participate in telecommuting. For example, the Fire Chief decided not to have his employees participate after they had completed training. The City Clerk, because of staffing constraints, did not approve training for any of his employees, although they were allowed to be members of the control group. Some recommended (by JALA) employees in both of these departments volunteered to serve as members of the control group for the mid-term and/or final evaluations.

In general, the remaining departments approved only their very best people for the project; both the telecommuters and the members of the control group were rated by their supervisors as being in the upper third of those employees with similar experience. Consequently, although JALA recommended more than the target of 500 telecommuters for training—and trained almost 90% of the target group—only about 75% of the number trained seem to have been approved by their department management (as estimated by the number of agreements received by the Project Manager). Of those who were trained, 55 had retired or transferred to non-participating units by the end of the project. Of the remaining 321 trainees, 156 (64% of those who had signed agreements to complete the questionnaires) had returned the final evaluation questionnaires by

December 1st. "Questionnaire fatigue" is a common problem in evaluation studies. In this case the resolve of the participants was further tested by the length of the final questionnaire — more than 500 items.

Table 2: Department Status in Early 1993

Department	Trained	Currently Active	Never Started	Transferred/ Reassigned	Promoted	Left Department	Voluntarily Quit Telecom-muting	Supervisor Terminated Telecom-muting	Comments
Building and Safety	41	14		11	3	6		7	Needed 7 for public counter service
City Attorney	22	11		1	1			9	Participation cancelled at nominal end of project
City Planning	28	14	6	3		2	3		
Community Development	9	4	1	2		1		1	Not enough to do at home
Controller	11	4	7						
Employee Relations Board	3	2	1						No computer available for employee
Environmental Affairs	3	1					2		
Fire	11	0	11						Participation cancelled by Chief Engineer and General Manager
General Services	10	0						10	Participation cancelled at nominal end of project
Harbor	5	0						5	Participation cancelled at nominal end of project
Information Services	48	26	22						
Library	29	13	5	2		3	5	1	Too difficult to carry books around; face-to-face needs
Pensions	7	5		1			1		Long term medical leave
Personnel	14	4	2	3		5			
Police	115	66	23	22		3	1		Medical leave
Public Works[2]	15	16		2	1			2	End of project; insufficient task definition
Recreation and Parks	8	6			1	1			
Telecommunications	5	3		1			1		Long term medical leave
Transportation	12	2	1	5	2			2	Daily face-to-face meeting schedule
Water and Power	45	12	30	2		1			
TOTALS	**441**	**203**	**109**	**55**	**8**	**22**	**13**	**37**	

This failure of departments to "activate" trained telecommuters is a serious issue since telecommuting's highest City priority is as a transportation demand management tool. If telecommuting is to become a significant means of reducing traffic congestion, then a fairly large percentage of City employees will eventually have to become at least part time telecommuters[3]. The Telecommuting Project was a primary way of giving

[2]Public Works added 6 telecommuters, using the training materials provided by JALA during the formal sessions.

[3]Our analysis of City job titles indicates that about 16,000 permanent City employees could become at least part-time telecommuters. See the chapter on impacts.

City managers the opportunity of honing their management skills. Yet entire departments missed that opportunity. Others took only very tentative steps.

The final status of the telecommuters in the project is given in Table 2. Overall, 338 participants telecommuted at some point in the project, with 203 still active as of February, 1993. Note that some departments, and some organizational units of departments, elected to discontinue telecommuting at the nominal end of the project, affecting 25 telecommuters — all of whom wished to continue telecommuting.

Types of Employees

First, as a test of the breadth of the selection process, Table 3 shows the breakdown by the type of work reported by the participants.

Table 3: Reported Types of Jobs

Job Type	% of Telecom-muters	% of Non-Tele-commuters
Architect	1.9	3.9
Policy Analyst	1.3	1.3
Finance	1.3	1.3
Research & Development	1.3	1.3
General Administration	7.7	3.9
Public Safety	20.0	7.9
Customer Service	1.3	1.3
Field Service	0.0	2.6
Office Services	1.3	5.3
Office Systems	1.9	0.0
Engineering	9.7	13.2
Accounting	3.9	2.6
Legal	7.7	3.9
Human Resources	5.2	10.5
Information Services	16.1	22.4
Program Management	3.2	2.6
Planning	7.7	1.3
Other	8.4	14.5

Telecommuters and Controls

As of 1 December, 1992, we had received completed final evaluation questionnaires from 156 active telecommuters and 79 non-telecommuters in this group of respondents. This is a sufficient number to get a reasonable idea of the differences, if any, between telecommuters and non-telecommuters after more than a year of telecommuting.

Of the telecommuter group, 5.2% considered themselves to be primarily managers, 66.7% considered themselves to be primarily professionals, 19.0% claim both managerial and professional roles, 6.6% are paraprofessionals or secretaries, and 2.6% classify themselves in the “Other”

category. Clearly, *it would have been more revealing if significantly larger numbers of paraprofessional, secretarial and clerical workers had been included in the project,* since the City employs fairly large numbers of people at these levels. Nevertheless, there is clearly a broad spectrum of job types represented in this group. The distribution of control group members differs slightly, with 2.6% managers, 58.4% professionals, 24.7% as combined manager-professionals, 13.0% as paraprofessionals or secretaries, and 1.3% as "Other."

The average telecommuter is 38.9 years old[4], has worked for the City 13.6 years, for his/her Department 5.1 years, in his/her particular job 4.0 years and has a gross annual salary of about $50,600. The average size of the unit in which the participant works is 12.3 people; the median work unit size is 8. Most, 84.2%, of the telecommuters in this sample work in or near downtown Los Angeles.

The telecommuters do not take much sick leave, except for maternity leave; the median annual number of sick days taken in 1989 was 6, with 5 days in 1990 and 4 as the median in 1991 during telecommuting. The telecommuters decreased the average number of sick days taken between 1989 and 1990 by 1.2, and between 1990 and 1991 by 1.8. Most of the overall reduction in the most recent year was a result of an average 3 day reduction[5] by female telecommuters, presumably related to the telecommuting advantage in the care of sick children.

Most of the telecommuters own their own homes, averaging 1849 square feet. Their average electricity bill is $98, the gas bill is $23 and telephone charges average $73 per month. The apparent telephone bill increase[6] for telecommuters, since most departments are not paying for home telecommuters' phone charges, is only $3.59 per month. Even this $3.59 difference may be misleading, since the telecommuter data include one very large telephone bill ($860). The median telephone bill for the telecommuters was $51, making their bill $7.50 less than that of the control group. Therefore, we conclude that there is no significant difference in the telephone costs between the two groups. Yet, telephone bills are generally thought to constitute the largest operational cost element for telecommuting.

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[4]The average age for males is 39.8, for females it is 38.2 years.

[5]The reduction was more than 5 days per year, compared with female members of the control group.

[6]As compared with the bills for the control group.

The average control group member is 41.0 years old[7], has worked for the City 14.5 years, for his/her Department 5.7 years, in his/her particular job 4.7 years and has a gross annual salary of about $47,800[8]. The average size of the unit in which the control group member works is 12.9 people; the median work unit size is 9. As with the telecommuters, almost all, 94.7%, of the control group members in this sample work in or near downtown Los Angeles.

Also like the telecommuters, the control group members do not take much sick leave; the median annual number of sick days taken were 6 in each of 1989 and 1991, 5 in 1990. On the other hand, the average telecommuter took 2 sick days (or 33.3%) less than the average non-telecommuter during the telecommuting period.

Most of the control group members own their own homes, which are slightly larger than the telecommuters', averaging 1918 square feet. Their average electricity bill is $94, the gas bill is $28 and telephone charges average $69 per month, with a median telephone charge of $58.50. In short, the members of the control group match the telecommuters fairly closely in their general characteristics. The major difference is a utility bill (including telephone charges) of about $3.09 per month more for the telecommuters.

Men have a slight majority among the participants, 53.3% of the telecommuters and 57.9% of the control group. About two-thirds, 66.7%, of the telecommuters and half, 51.3%, of the control group members live in dual earner households.

Forty seven percent of the telecommuters and 22.1% of the control group members are on a traditional work schedule: five 8-hour days per week. Only 5.8% of the telecommuters and 3.9% of the control group members work on the 4-10 schedule (four 10-hour days per week), while 45.5% and 74.0%, respectively, are on a 9-80 schedule (five 9-hour days one week; three 9-hour days and one 8-hour day the next week).

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[7]The average age for males is 41.2, for females it is 40.4 years. In 1990, male and female federal workers averaged 43.6 and 40.5 years, respectively. as compared with 37.3 years for both male and female employees in the private sector. Hence, City employees are roughly comparable in their age demographics to other information workers.

[8]Men in the control group average $51,600 while women receive an average of $42,800 per year. The salary gap between male and female telecommuters is not as large, with males averaging $52,300 and females averaging $49,000 per year. Either way, however, the male-female salary gap is statistically significant at the 0.0016 level.

Accomplishments

In this report, the overall accomplishments of the project are summarized. For more detail, the reader is advised to examine one or more of the individual project reports.[9]

Commuting Data

A primary goal of the Telecommuting Project is to reduce commuting. Hence, the commuting patterns of the participants are very important. As was mentioned earlier, most of the participants who have responded to the evaluation questionnaires commute to City Hall or the general downtown Los Angeles area.

Residence Location

There is no particular pattern of residence locations for City employees. One hundred forty different residence zip codes were identified by the 235 employees who returned the final evaluation questionnaires.[10] The two most "intensely" populated zip code areas have 5 employees living in them. This acts to complicate the problem of satellite telework center selection since there are no obvious, unequivocal locations that pop out of the data.

Commute Distances and Times[11]

The average one-way commute distance for the active telecommuters is 22.8 miles[12]; the median commute is 20.0 miles. The minimum one-way commute for a telecommuter is 3 miles, the maximum is 67 miles and the mode (the most common distance) is 15 miles.

The non-telecommuters' average one-way commute is 23.1 miles; the median and the mode are 23 and 26 miles, respectively. Their reported commute distances range from 7 to 60 miles.

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[9]There are three cost-benefit analysis reports; two focus group summary reports; and special reports on departmental impacts; area-wide impacts; labor, managemant and legal issues; and barriers to telecommuting. These reports are available from the Department of Telecommunications.

[10]As contrasted to the 161 different zip codes, with a maximum of 8 in a single zip code, identified by the 304 employees who returned mid-term evaluation questionnaires.

[11]Note: the commute times and distances are taken from the mid-term evaluation and trip analysis data. Through a clerical error, the commuting data portion of the final evaluation questionnaire was omitted from all but 40 of the questionnaires; only 15 of these were returned by the reporting deadline. However, since household moves were reported in a different section of the questionnaire, the mid-term data should be applicable to the final situation.

[12]The 31.9 mile average found in the baseline survey implies that the first group of telecommuters was biased toward those applicants who lived at greater than average distances. The mid-term survey had an average one-way commute of 24.9 miles and a median of 21 miles. The mid-term maximum was 170 miles.

Commute times from home to the office average 48.3 minutes for the telecommuters and 44.8 minutes for the non-telecommuters. The median morning commute times are 45 minutes for both groups. Afternoon commutes are significantly longer for both groups, averaging 58.1 minutes for the telecommuters and 57.4 minutes for the non-telecommuters, respectively. That is, the telecommuters average 106 minutes per day commuting, when they commute, and the non-telecommuters are on the road an average of 102 minutes per day, not much difference. ***If these people were to commute 220 days per year, each of these group members would spend about 9.6 work weeks (24 waking days) per year on the road***[13]**.**

Commute Modal Choices

Three of every five (61.4%) of the telecommuters drive their own cars to work at the rate of least four days per week when they are commuting, a slightly higher proportion than the 58.7% of the non-telecommuters who do so. Seventy-one percent of the telecommuters and 70.7% of the control group members do not belong to a car- or van-pool (ridesharing). Similarly, 26.7% of the telecommuters and 34.7% of the non-telecommuters do not drive their own cars at all to work. The average number of days per week each group drives to work is 2.6 days and 2.8 days per week, respectively for the telecommuters and non-telecommuters. Twenty-nine percent of the telecommuters carpool at least one day per week, versus 20.7% of the non-telecommuters. On average, the telecommuters carpool 1 day per week, as contrasted to 0.82 days per week for the non-telecommuters. The average days per week taking the bus are 0.31 and 0.63, respectively.

Of those who rideshare, 34.1% of the telecommuters and 52.4% of the non-telecommuters drive to their pickup point. Since each of these trips involves an engine cold start, the pollution reducing advantage of ridesharing is significantly diminished. The average trip time to the rideshare pickup point is 8.4 minutes for the telecommuters and 9.5 minutes for the non-telecommuters.

In short, telecommuters live slightly farther from work than do the non-telecommuters and they are about as likely to drive alone when they do commute. Overall, the commuting patterns of both groups are similar. Note that significant numbers of those using carpools and vanpools in both groups report driving their cars to the pool pickup

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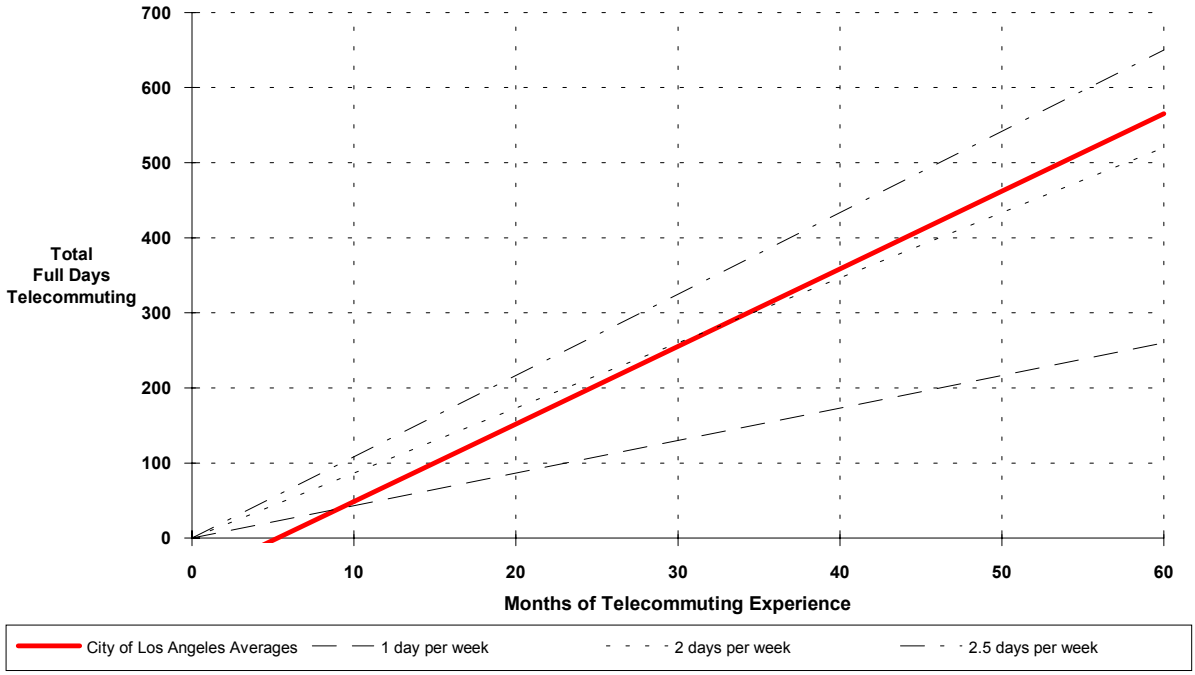
[13]A work week is taken as 40 hours; a waking day is 16 hours, under the assumption that most people get about 8 hours sleep per day and that this does not occur while they are commuting. Waking days constitute potential disposable time for the telecommuters. Work weeks constitute potential productive time for employers.

location. Therefore, a high percentage of their telecommuting will result in real net trip savings and air pollution reduction.

Level of Telecommuting Achieved

Of the 325 individuals who had responded to our final survey by December, 156 were active telecommuters. Of the active telecommuters, 62.2% have been telecommuting more than 1 year, with only 7.7% who have been telecommuting less than 6 months.

Figure 1: Projected Telecommuting Rates



The nominal goal for the project was to have participants telecommuting at least one day per week, on average, with a nominal maximum average of two days per week. Some jobs are suitable for almost full-time telecommuting, in our experience, while others might encounter difficulty reaching the one-day-per-week goal. Some of the telecommuters found that they could not continue telecommuting at the same rate that they tried the first month. Others found that they could increase their rate of telecommuting. Still others have maintained their original rate. The overall average for the first month of telecommuting was 4.0 days, with median and mode also at 4 days and the range going from 1 to 23 days. For the first month of their telecommuting, 99% of the telecommuters worked at home 8 days or less.

In practice, the number of telecommuting days per month tends to increase over time. An analysis of the historic data for the project shows an expected average of 4.2 days per month for those who have been telecommuting for a year.

Telecommuters with two years of experience are likely to be telecommuting about 8 days per month. For comparison, the State of California Telecommuting Pilot Project showed an average of 5.2 days per month at the end of the first year of telecommuting and 6.5 days per month at the end of the second year. A linear regression analysis[14] of the Los Angeles telecommuting frequency data indicates that the telecommuters will tend to telecommute about 2.4 days per week as they gain experience with telecommuting. Figure 1 shows the regression line. Note that the line begins only after a few months of telecommuting. This is indicative of the fact that beginning telecommuters tend to telecommute one or fewer days per week.

Although the training sessions for the telecommuters stressed that only full days of telecommuting would count, since the primary objective is to eliminate car trips, some partial day telecommuting was expected. In fact, 27 of the telecommuters also did some part-day telecommuting, one of them for 10 days in the most recent month before the survey. Half of the part-day telecommuters left home for the office between 7:00 and 9:00 a.m., the center of the time span proscribed by the SCAQMD in Regulation XV. Hence, this telecommuting had essentially no positive impact on the air quality problem.

One concern with telecommuting is whether it will increase car use, since an "extra" car may be available when the telecommuter is working at home. Twenty-three percent of the telecommuters said that the car was indeed used by themselves or someone else in their household when they worked at home (the remaining 76.9% maintained that it was not in use). **Of those who stated that their car was available, 23.1% (5.8% of all the telecommuters) stated that there was an overall decrease in non-commuting car use in addition to the decrease due to telecommuting!** To counter this, 23.1% (5.8% of all the telecommuters) stated that there was some additional car use, but not enough to counteract the telecommuting reduction. An additional 5% of the car-available group (1.3% of all telecommuters) said that their added non-commuting car use acted to cancel the reduction from telecommuting. In summary, only 8.4% of the telecommuters reported any erosion of the car use savings.

[14]Linear regression is a statistical procedure that fits a straight line to a set of data points. In this case the data points are length of time telecommuting and the number of telecommuting days during that period.

Analysis of the detailed trip logs[15] that were administered in March, 1992, showed that some of this additional car use was the result of telecommuters performing chores that otherwise would have been carried out by other family members. Hence, the slight additional use of their cars by some telecommuters may be overstated, since many of the "new" trips replace trips that would have occurred anyway. The net result of the actual trip measurements was an overall reduction in car use over and above the telecommuting reduction. ***At this point, to be conservative, we conclude that telecommuting produces exactly the car use reduction that equals the reduction in commute trips. Therefore, it completely satisfies the primary goal of the project: telecommuting-eliminated trips are not replaced by other trips.***

The most popular locations for the telecommuters' home offices are the den or study (20.8%), a spare bedroom

Table 4: Activities Performed While Telecommuting

Activity	% who engage in it
Thinking/planning	69.2
Reading	68.6
Writing (without a computer)	55.1
Text/word processing	58.3
Research	55.1
Coordinating by telephone	44.9
Record keeping	17.3
Computer programming	20.5
Working with data bases	22.4
Other	20.5
Graphics/layout	10.9
Coordinating via computer	8.3
Having meetings	2.0

(29.9%) and the dining room (13.0%). The average space used for telecommuting is 173 square feet (about 9% of their total floor space), with an average of 133 square feet used exclusively for telecommuting. Eighty-three percent of the telecommuters own their own detached-structure homes, 6.5% live in apartments and 7.7% live in condos or townhouses. The median home has 7 rooms.

The average telecommuter allocates about 37% of his/her weekly work tasks for the telecommuting period. *Given the overall average of 0.9 days per week telecommuting, that works out to 37% of the work being accomplished in 18% to 23% of the work week; possibly an average 100%*

[15]Cf. the project report: *Telecommuting Travel Impact Analysis: Los Angeles Telecommuting Pilot Project*, July 1992, by JALA Associates.

productivity increase per telecommuting day. Table 4 shows what the telecommuters are doing when they telecommute. While 17.5% of the telecommuters view telecommuting as a temporary or occasional thing, 82.5% (up from 77% at the mid-term survey) consider it to be a permanent change to their working ways.

Performance Changes

An important criterion in assessing the desirability of telecommuting is its impact on employee effectiveness. As a minimum acceptance criterion, overall work performance should not degrade from its pre-telecommuting values. As is the case with the quality of life factors, we have concentrated on assessing ***changes*** in, rather than absolute values of, worker effectiveness. Several indirect measures of effectiveness factors are included in our evaluating survey questionnaire. However, the most numerically clear test is a direct question asking each respondent whether, and how much, their effectiveness changed since telecommuting began.

Quantitative Estimates

Of the group of telecommuters, the range in their self-estimate responses ran from no change (twenty cases) to increases of 100% (five cases). The average response for all the reporting telecommuters was an increase of 29.9% with a median response of a 25% increase. In the case of the non-telecommuters, the range in responses ran from a decrease of 50% (one case) to an increase of 100% (three cases)[16]. The average response for the non-telecommuters was an increase of 23.8%, with a median response of 20%. The difference between the telecommuters' and non-telecommuters' average self-estimates of effectiveness change is 6.1%. The difference is significant at the 0.09 level.[17] About 13% of the telecommuters and 25% of the non-telecommuters indicated no change in their effectiveness since telecommuting began.

Note that the above figures are derived from the *employees'* responses. Typically, supervisors' estimates of employee effectiveness are lower than those of the employees themselves. Consequently, a parallel survey was made of the participants' supervisors. The supervisors' estimates of the telecommuters' effectiveness changes averaged 21.8%; their estimate of control group members' effectiveness changes averaged 9.3%, a difference of 13.5%. In this case,

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[16]Non-telecommuters can increase their effectiveness through such means as more experience or training, fewer interruptions from (telecommuting or other) co-workers, greater maturity in work attitudes, etc.

[17]That is, the odds are 10 to 1 that the difference is meaningful.

the difference is significant at the .008 level.[18] Twenty-five percent of the telecommuters' supervisors and 48% of the control group members' supervisors indicated no change in effectiveness. Hence, **the telecommuters are showing clear effectiveness improvements relative to the members of the control group, *particularly* in the estimation of their supervisors**.

There are some clear differences of opinion between supervisor and employee concerning effectiveness change. The telecommuters' self estimates tended to agree more closely with that of their supervisors. Nineteen percent of the telecommuters and supervisors agreed exactly on the effectiveness changes; 8% of the supervisors and control group members agreed. Twenty-six percent of the telecommuters received higher ratings from their supervisors than they gave themselves. Twenty-one percent of the control group members received higher than their self-ratings from their supervisors. The most interesting aspect of these results is that the supervisors' estimates have a much greater difference between telecommuters and non-telecommuters than do the individuals' self-estimates.

Qualitative Estimates

A more qualitative view of the impact of telecommuting was obtained in the focus group meetings that were held at intervals during the project. These views are more indicative of attitudes, rather than of measurements made during the project.

Supervisor/Subordinate

One supervisor, commenting on the attitude toward telecommuting of other managers in the organization, quoted them as saying: *"Why commit to it when it'll go away?"* In another department, the perceived attitude of upper management was more actively hostile. In most departments, a mixture of pro- and con- attitudes was perceived. In all of the focus group sessions requests were made for more publicity about the project, particularly directed at upper management.

On the positive side, all of the supervisors attending the sessions felt that telecommuting should be continued after the end of data-taking. Some supervisor's comments:

> *"It's [succeeded] to the point where you have to make a case NOT to telecommute;"*
>
> *"This is not a benefit; it's management deciding where work is to be done—as needed;"*

[18]Here, the odds are 127 to 1 in favor of a meaningful difference.

"I can count the hours gained by one of my female telecommuters with child care problems; it's a major improvement;"

"You just can't keep up with required reading without telecommuting."

Telecommuting has proved to be a communication enhancer for both telecommuters and supervisors/subordinates*: "I like to call you when you're telecommuting because I know I have your undivided attention"* or *"It's the only time when I know that I can get in touch with you."* Note that this works both ways; the first quote is by a telecommuter about his supervisor. This enhanced communication, coupled with the increase in decision making by telecommuters, has allowed at least one manager to cope with a growing staff.

This combination of enhanced communication and increased telecommuter responsibility was a recurring theme of the focus groups. In contrast, some managers' apparent preoccupation with control was also a recurring theme. One supervisor commented on the non-participation of one of the City departments in the project: *"The mini-micro-management mentality of [the department] will keep them from taking advantage of telecommuting."* Several telecommuters in one department noted that the products of their telecommuting days were given far more scrutiny than their in-office work:

> *"I have to turn in my [telecommuting day's] work for inspection as soon as I come in to the office on the following day. If I'm not finished, I have to personally explain to the division manager; this doesn't happen on non-telecommuting days."*

This is a common phenomenon at the outset of a telecommuting project. It tends to diminish or disappear as telemanagers gain more experience. Some of the longer-term telecommuters in the groups, and several in the 1992 groups, said that their supervisors relaxed noticeably once they saw the improved, on-time output from the telecommuters.

Nevertheless, the continued demonstration of these attitudes led to the recommendation, in almost every one of the 1992 meetings, that mid- and upper-level supervisors, as well as direct supervisors, be given telecommuting training. Appendix 3 includes quotes from the final supervisors' evaluation questionnaires.

Two supervisors stopped their employee's telecommuting because of performance drops. In one case, the employee could not assemble enough work to telecommute entire days at a time. In the other case, the employee was simply

unable to adequately identify deliverables, set up a schedule and set priorities.

Colleagues

As expected, the primary reaction of non-telecommuting colleagues of telecommuters was felt to be envy. A frequent remark in the sessions was that neither colleagues nor supervisors thought that telecommuting was "real" at first. Once they discovered that telecommuting was actually happening, they felt left out. In some cases, outright hostility was perceived*: "One person won't even talk to me anymore."* In most cases this initial friction has diminished or even turned into support.

The requirements for telecommuting are being disseminated informally among the telecommuters' colleagues. One telecommuter remarked: *"The rest of the people in my group know who the slackers are. They would really complain if any of [the slackers] were selected for telecommuting."*

The question of reduced casual interaction among co-workers remains. Some individuals felt that their interaction was reduced, while others felt it had increased, although often on the phone instead of face-to-face.

We regularly asked focus group attendees whether their co-workers would be disposed to telecommute. Several participants mentioned that their colleagues originally declined to participate in the project because of its pilot status. They [the colleagues] felt that it would be too much of a risk/disappointment *"to get all fired up about telecommuting, then have it turned off suddenly."* A certain amount of *"I told you so"* commentary was received by Harbor Department telecommuters after they were told to stop telecommuting after June 30, 1992.

A different view of colleagues' attitudes was offered by another telecommuter: *"When they [the co-workers] found out they had to be accountable for their work, their enthusiasm went way down."* This from co-workers who were accusing the telecommuters of goofing off.

These and similar incidents led several telecommuters to suggest that telecommuting training be given to non-telecommuters as well as to the telecommuters.

Training Influences

One of the elements of the analysis is to see whether the initial training sessions for the project had any influence on the effectiveness outcomes. Table 5 shows the effectiveness estimates as a function of who was trained. A direct reading of the table can be slightly misleading, since there are only a few cases among the telecommuters where either no one or only the supervisor was trained. The overall

evidence is that it is particularly important that supervisors receive training.

Table 5: Estimates of Effectiveness Increases by Level of Training

Training Received by:	Supervisors' Estimates		Self-Estimates	
	Telecommuters	Non-Telecommuters	Telecommuters	Non-Telecommuters
Neither	21.4%	6.0%	33.3%	21.3%
Telecommuter only	14.7%	11.0%	31.8%	21.2%
Supervisor only	38.3%	8.8%	30.7%	33.0%
Both	23.3%	12.5%	28.9%	26.9%

Quality of Work Life Changes

Aside from the quantitative effects of telecommuting, there is the issue of the socio-psychological effects of telecommuting. What is the impact of telecommuting on the telecommuters and their families? We do not develop direct evidence of the effects on the families, rather we asked the telecommuters about the impacts. We included a section in our evaluation questionnaires specifically oriented toward these impacts.[19] Common factor analysis of the questionnaires allows us to break a number of the work/social impacts into 11 categories, as follows:

1. *General Work Life*. This relates to changes in the individual's relationships with his/her supervisor, self assessment of job skills, feelings of job responsibility, influence, versatility and scope.
2. *Personal Life*. This factor includes changes in quality of family relationships, discretionary time, feelings of control of one's life, ability to separate work and home life, success in self discipline, coordination of family and work time, and knowing when to quit work.
3. *Visibility*. Do telecommuters feel out of their supervisor's and co-workers' minds when they're out of sight? This factor includes changes in one's influence on organizational strategy, understanding of what others are doing, how well one's suggestions are received and self assessment of visibility in the organization.

[19]We developed this component (as well as the other components) of the questionnaire in studies of telecommuters and other information workers carried out over the past 16 years. It contains 50 questions about the extent and importance to the respondent of any impacts.

4. *Environmental Influences*. This includes changes in home office space, stress from environmental noise, ability to match work and biorhythms, and feelings of self empowerment.
5. *Belonging*. Do telecommuters feel themselves to be loners? Here we have changes in involvement in office social activities, amount of job-related feedback, career advancement, job stability and relationships with fellow workers.
6. *Creativity*. Changes in: creativity in one's work, the amount of flexibility in job performance and feelings of self empowerment, are in this factor.
7. *Stress Avoidance*. Changes in work related costs, ability to bypass physical handicaps and avoidance of office politics are grouped here.
8. *Liberation*. This factor includes changes in ability to concentrate on crucial tasks, the need to cope with traffic, and the ability to get more done.
9. *Apprehension*. Changes in uneasiness about equipment failure and feelings of guilt about "not really working" constitute this category.
10. *Interdependence*. This factor relates to changes in the quality of meetings with colleagues and dependence on others to help perform one's job.
11. *Continuity*. The final factor calibrates changes in freedom from interruptions.

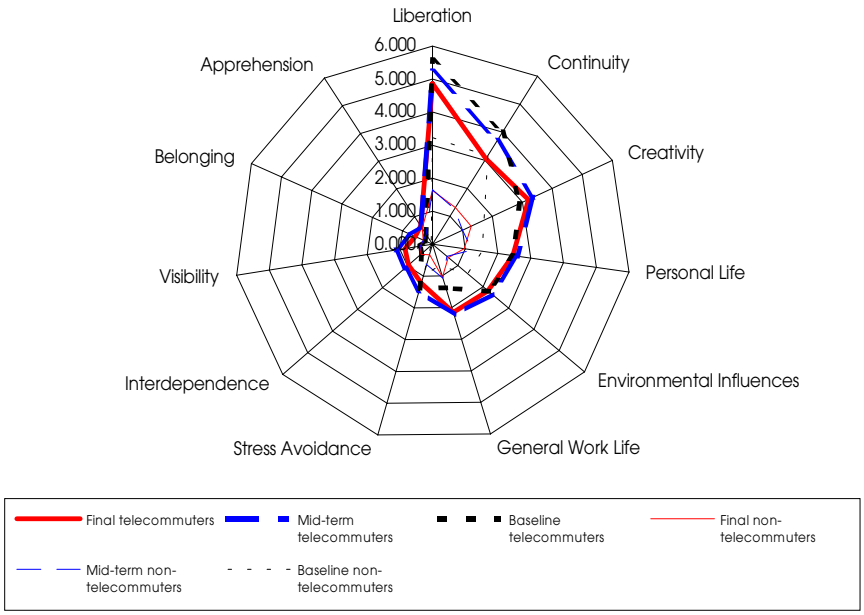
Table 6: Work/Social Factor Changes

Factor	***Telecommuters***	***Non-Telecommuters***	***Difference (T - non-T)***
Liberation	4.9	1.6	3.2
Continuity	3.1	1.3	1.7
Creativity	3.2	1.3	1.9
Personal Life	2.5	1.0	1.5
Environmental Influences	2.2	0.6	1.6
General Work Life	2.2	1.0	1.1
Stress Avoidance	1.2	0.3	0.9
Interdependence	1.0	0.5	0.5
Visibility	0.9	0.4	0.5
Belonging	0.6	0.3	0.3
Apprehension	0.7	0.6	0.1

Note that the emphasis is on *changes* in these categories. We asked the participants what had changed since telecommuting began, whether or not they were telecommuters. We asked how much, if any, change there was and how important each issue was to them. We have developed composite values (amount of change multiplied

by importance to the participant) for these factors, as shown in Table 6. The scales for *amount* of change are from -2 to +2, with -2 signifying much worse, 0 meaning no change, and +2 signifying much better. Importance ranges from 0 (not important at all) to 4 (extremely important to the participant). Thus, the composite factor can range from -8 (i.e., -2 × 4) to +8 (i.e., +2 × 4).

Figure 2: A "Radar" View of the Quality of Life Changes

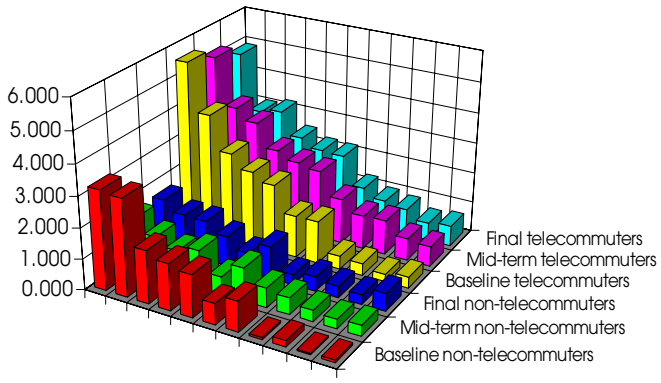


The surveys show clear differences between the telecommuter and non-telecommuter groups. There are three areas in which we might expect to see negative impacts from telecommuting: Visibility, Apprehension and Belonging. Yet, this group of telecommuters, on average, shows net positive changes for all three, although there are some individual negative responses.

Figures 2 and 3 show two different views of the elements of Table 6 as well as the comparable results from the mid-term and baseline surveys. Note that, with the exception of the liberation and continuity factors, both groups at mid-term appear to be more positive than they were during the baseline survey; then both groups tended to decline slightly from the mid-term to final surveys. In two of the key factors — continuity and creativity— the telecommuter group switched rankings between the mid-term and final surveys, while the non-telecommuters stayed about the same. This could arise from a possible increase in interruptions to the telecommuters as more people get used to contacting them while they are at home, coupled with a decrease in interruptions in the office as the on-site office population decreases. Interestingly, the telecommuters' responses to the liberation and continuity factors declined

after the baseline measure, showing the effects of reality slightly modifying expectations.

Figure 3: Comparative Quality of Life Changes



In any case, the telecommuters show quality of life changes that are more positive in every respect than those of the non-telecommuters.

Energy Use

Direct Usage

Telecommuting *uses* more energy to the extent that it increases the use of telecommunications over what would occur without telecommuting. For example, if more phone calls are made by telecommuters than by non-telecommuters, or if the phone calls are over longer distances or last longer than would be the case otherwise, then there is a net increase in energy use proportional to the energy costs of the additional calls. Furthermore, if telecommuters work at home, they may use more energy — in lighting, heating and cooling — than they would if they were not at home. This is particularly true if no one would be at home otherwise (thus, the lights and furnace or air conditioner would be turned off or down).

Telecommuting *saves* energy to the extent that it reduces gasoline consumption or reduces building heating, ventilation, air conditioning and lighting in the offices no longer occupied by the telecommuters. The latter is the reverse of the increase in energy use produced by a home telecommuter.

Indirect Usage

There are indirect energy effects as well. For example, if telecommuting increases the use of computers, it also

increases the energy put into the computer industry. to the extent that telecommuting causes changes in the *form* of energy used, as from gas to electricity, or in the *efficiency* of energy use, there is an impact on energy resource demand.

As another example, if telecommuting reduces automobile use, then it also has a ripple effect on the amount of energy expended in automobile manufacturing and maintenance, highway construction and the information infrastructure supporting those sectors of the economy.

Results

It was not possible to directly measure the direct usage, or even to estimate the indirect energy usage. Further, because of the already high load of questionnaires and meetings requiring the telecommuters' time, we limited the energy assessment to indirect methods. Specifically, we estimated telecommunications, electrical and natural gas energy use by asking the participants to note their telephone and utility bills. Gasoline energy use was estimated by factoring an assumed average fuel mileage (24 miles per gallon of gasoline) for the participants' cars with their known commute distances and commuting patterns.

As the demographic data given earlier indicate, there is no statistically significant difference

between the telecommuters and the non-telecommuters in telephone or home utility use. The fundamental difference is in fuel use. The difference amounts to a net saving of 4018 kilowatt-hours per telecommuter-year at the 1992 average telecommuting rate of 1 day per week. For comparison, the 1988 average annual energy consumption per capita in the US. was about 31,700 kilowatt-hours.[20] *Therefore, the average City of Los Angeles telecommuter in 1992 was reducing his/her total energy use by about 13%.*

As the rate of telecommuting increases, the resulting energy saving can also be expected to increase. Further, although we did not calculate the indirect energy impacts, it appears plausible that any increases in telecommuting-related infrastructure use are more than compensated for by energy reductions in the transportation infrastructure.

Air Quality

The effect of telecommuting on air quality is directly the result of decreased automobile use. Automobile-produced air pollution is often characterized as consisting of two phases: the cold start and hot running phases. The term *cold start* refers to the fact that an internal combustion

[20]The actual calculation is: 327 million Btu's per capita divided by 10,331 Btu's per kilowatt-hour equals 31,652 kilowatt-hours per capita.

engine that is at ambient temperature produces significantly more pollutants than an engine that is running at its nominal operating temperature. The cold start period, although somewhat dependent on the ambient temperature, is from 10 to 15 minutes under typical operating conditions. The SCAQMD rules concentrate on cold starts, generally ignoring the hot running phase. If a car has been idle for more than 8 hours, its next start is assumed to be a cold start.

The current version of Regulation XV, in order to make the necessary calculations fairly simple, gives full credit, for a trip not taken, to carpool and vanpool riders. However, the formula for satellite telecommuters is more complicated. Full credit is given only for telecommuters who reduce their one-way commute by at least 20 miles.[21] Half credit is given to telecommuters who reduce their commute by at least 50%, even if the one-way commute distance saving is less than 20 miles.

Paradoxically, our analysis of the travel patterns of City employees indicates that 52% of those who participate in car- or van-pools drive their cars to the pickup point. The average trip time for that drive is 9.5 minutes. Thus, at least half of the car- and vanpool activities involve as many cold starts as if the participants were driving their cars all the way to work. Home-based telecommuting, according to our data, completely eliminates the cold starts associated with commuting. Satellite office telecommuting, if the commute distance is longer than a few blocks, probably does not reduce cold starts. Yet satellite office telecommuting, as well as car- and vanpooling, can materially reduce the total vehicle miles traveled (which is not counted under Regulation XV). Hence, there is considerable strain between Regulation XV and the realities of automobile-induced air pollution. That is, the rule is biased in favor of rideshare participants and against satellite office telecommuters.

Our air pollution calculations are based on the hot running rate of pollution production for cars, in accordance with the *Mobile 4* specification from the Environmental Protection Agency. Therefore, because they miss the cold start period, they understate the impact of telecommuting. We calculated the air pollution that would have been produced by each telecommuter's car, had they not been telecommuting. The results are as follows, in terms of the

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[21] Our analysis of a set of 580 potential telecommuters, together with a set of 36 possible regional satellite office locations, indicates that 91% of the telecommuters would save less than the required 20 miles one-way by commuting to the center closest to their home. However, the remaining 9% produce more than half of the overall VMT savings.

annual level of pollutants *not* produced by the average City telecommuter:

- Carbon Monoxide: 275.6 pounds
- Nitrogen Oxides: 16.9 pounds
- Unburned Complex Hydrocarbons: 51.5 pounds
- Particulates: 1.2 pounds

Technology Requirements

One of the common misconceptions about telecommuting is that it requires intensive computer use; that it is not possible to telecommute unless access to a computer is available. While this can be true for computer programmers and some other professionals, it is not necessarily so for many other people. The dilemma for computer professionals is illustrated by the composition of the non-telecommuter group of our sample; a large fraction of this group consists of individuals who either lack access to the mainframe or who otherwise need computers but do not have their own personal computers at home.

Part of our inquiry deals with the extent to which various forms of technology are useful to City employees. There are two aspects to this inquiry. First, what are the minimum technology requirements for **any** form of telecommuting? Second, what is the effect of availability of a particular form of technology on *increasing the amount* of telecommuting?

We include in our list of "technologies" face-to-face meetings and other traditional forms of communication, since the effectiveness of telecommuting depends on the ability of some of the more electronic technologies to substitute for those traditional ones. Of the more "high-tech" technologies (computers, teleconferencing systems, etc.) 94.3% of the telecommuters and 93.7% of the non-telecommuters said these technologies greatly helped their work. We conclude that computers and sophisticated telecommunications are important to at least nine of every ten (up from four of every five at the mid-term evaluation) City information workers.

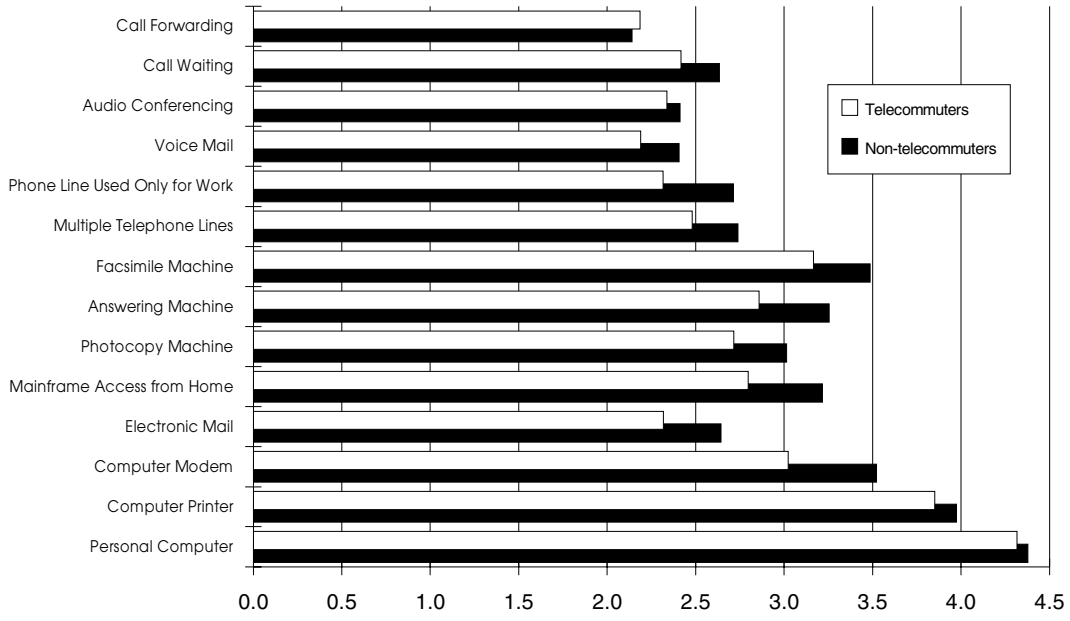
Personal Ownership

A test of what technology products are personally important is that of personal ownership. Although this obviously has some cost considerations, Table 7 gives the breakdown of personal ownership of technology among the two groups. Over the period of active telecommuting, a significant difference has developed in technology ownership in the two groups, particularly in the ownership of personal computers and related equipment. It is interesting to contrast computer ownership by the participants of the survey, a 67.7% overall average, with the 46.2% personal computer ownership claimed by the

Table 7: Technology Owned at Home by the Participants

Type of Technology	Telecommuters	Non-telecommuters
Personal Computer	73.7	58.2
Computer Printer	67.3	46.8
Computer Modem	39.7	19.0
Electronic Mail	10.3	6.3
Mainframe Access from Home	12.8	7.6
Photocopy Machine	9.0	7.6
Answering Machine	89.1	73.4
Facsimile Machine	18.6	12.7
Multiple Telephone Lines	30.1	19.0
Phone Line Used Only for Work	9.0	8.9
Voice Mail	3.2	1.3
Audio Conferencing	7.1	1.3
Call Waiting	42.9	25.3
Call Forwarding	14.7	7.6

Figure 4: Relative Power in Making Work Easier



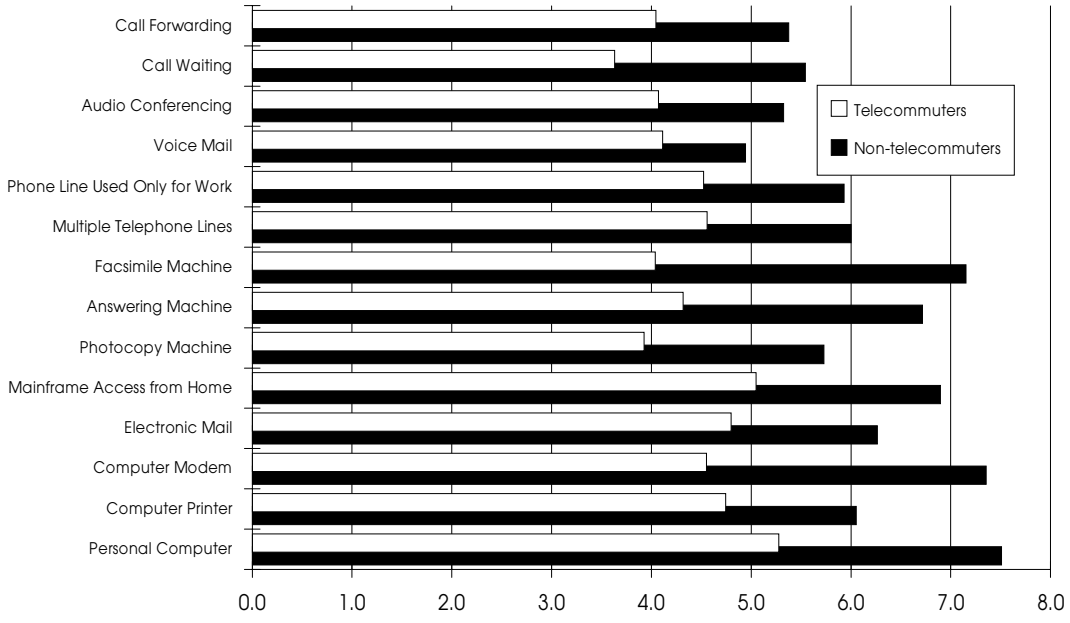
applicants to the project.

Table 8: Average Answers to:
How Much Easier Does This Technology Make Your Work?
(from 1 = No Effect to 5 = Very Great Effect)

Type of Technology	Telecommuters	Non-telecommuters
Personal Computer	4.3	4.4
Computer Printer	3.9	4.0
Computer Modem	3.0	3.5
Electronic Mail	2.3	2.6
Mainframe Access from Home	2.8	3.2
Photocopy Machine	2.7	3.0
Answering Machine	2.9	3.3
Facsimile Machine	3.2	3.5
Multiple Telephone Lines	2.5	2.7
Phone Line Used *Only* for Work	2.3	2.7
Voice Mail	2.2	2.4
Audio Conferencing	2.3	2.4
Call Waiting	2.4	2.6
Call Forwarding	2.2	2.1

One possible explanation for this disparity in computer ownership between telecommuters and members of the control group is that many of the telecommuters may have been on the verge of buying personal computers and their acceptance into the project triggered the purchase. Another possibility is that the internal departmental selection decisions were biased against prospective participants who did not own computers. As to the disparity in computer ownership between original applicants to the project and the members of the control group, it is possible that, since the project began, another 10% of City employees have purchased their own personal computers.

Figure 5: Power to increase Telecommuting (average days per month)



We also asked the participants how much *easier* various technologies made their work. Table 8 shows the results to date. It is clear that personal computers (with printers) and answering machines are key technologies for both groups. Interestingly, the non-telecommuters seem to prize technology slightly more than do the telecommuters. Figure 4 shows the same relationships in graphical form.

In addition to the questions on the general power of each of these technologies, we asked the participants to estimate what effect the availability of the technologies might have on their ability to telecommute. Figure 5 shows those estimates, given as the average additional telecommuting days per months made possible by the technology. Note that, for both of these questions, the non-telecommuters gave higher average estimates than did the telecommuters. This is particularly striking for the estimates of the ability of the technologies to increase the amount of telecommuting. Apparently, the telecommuters have a less optimistic (although still very positive) view of the ability of technology to increase the amount of telecommuting they do. In both cases, if all the estimates were added together they would total more days per month than are available.[22] Therefore, the estimates must be taken with a grain or two of salt. In either case, the highest ranked technologies are personal computers, their peripherals, and multiple telecommunications lines.

[22]More than double the available days for the telecommuters, triple that available days for the non-telecommuters.

Table 9: Perceived Availability of Various Technologies

Technology	Percent Availability	
	Telecommuters	Non-Telecommuters
Full-Motion Teleconferencing	2.7	0.0
Slow-Scan Teleconferencing	2.7	1.3
Computer Conferencing	9.5	18.2
Voice Mail	11.4	7.8
Cellular Phone	17.6	11.7
Outside Database Searching	22.6	13.2
Electronic Paging	25.9	14.3
Electronic Mail	26.2	32.5
Call Forwarding	31.8	36.8
Phone Conferencing	55.6	63.9
Express Mail	63.5	61.8
Database Development	64.4	66.7
Computer Graphics	65.8	65.8
Spreadsheet Analysis	66.4	72.4
Text Processing	67.3	62.3
Facsimile	73.6	77.9
Internal Mail	73.8	77.9
Specialized Computer Programs	78.1	74.0
Answering Machines	79.9	61.0
Regular Mail	85.1	81.8
Personal Computing	86.3	85.5
Meetings	96.1	87.0
Face-to-Face Conversation	96.8	94.8
Telephone	100.0	100.0

Use At Work

We also tested the relative importance to the participants' work of a broad array of technologies. We included traditional "technologies" such as mail, meetings and face-to-face conversation, as well as a variety of electronic and computer technologies. Since many fairly exotic technologies are included in our survey, the first task is to see how available the technologies are to the City employees participating in the project. Table 9 shows the results, listed in decreasing order of perceived availability. Note that these results depict the employees' *perceptions* about whether the technology is available to them at the workplace. Their perceptions may differ from reality to some extent. In general, there is little difference between the telecommuters and non-telecommuters. Apparently, a few employees believe that neither face-to-face conversation nor meetings are available to them!

Table 10: Overall Importance or Leverage of Technologies to the Respondents

Technology	Telecommuters	Non-Telecommuters
Full-Motion Teleconferencing	4.75	0.00
Slow-Scan Teleconferencing	2.50	3.00
Computer Conferencing	3.50	2.00
Voice Mail	7.00	9.83
Cellular Phone	6.96	10.25
Outside Database Searching	4.34	4.90
Electronic Paging	9.29	9.00
Electronic Mail	8.05	9.18
Call Forwarding	3.57	3.75
Phone Conferencing	3.58	2.78
Express Mail	2.64	2.58
Database Development	6.19	4.98
Computer Graphics	4.45	4.39
Spreadsheet Analysis	5.56	5.48
Text Processing	11.60	13.09
Facsimile	8.25	8.38
Internal Mail	11.78	12.58
Specialized Computer Programs	11.07	11.65
Answering Machines	9.66	11.35
Regular Mail	7.78	8.56
Personal Computing	14.52	13.84
Meetings	8.47	8.73
Face-to-Face Conversation	12.81	13.55
Telephone	16.71	17.47

We also asked the participants how often they used a particular technology and how important the technology was to performing their work. From these answers we derived a composite factor, we call *leverage,* that is a linear product of the other factors. Leverage values can range from 0 (meaning that the technology is either of no use or is not used) to 20 (meaning that the technology is used at least daily and is of immense importance to one's work).

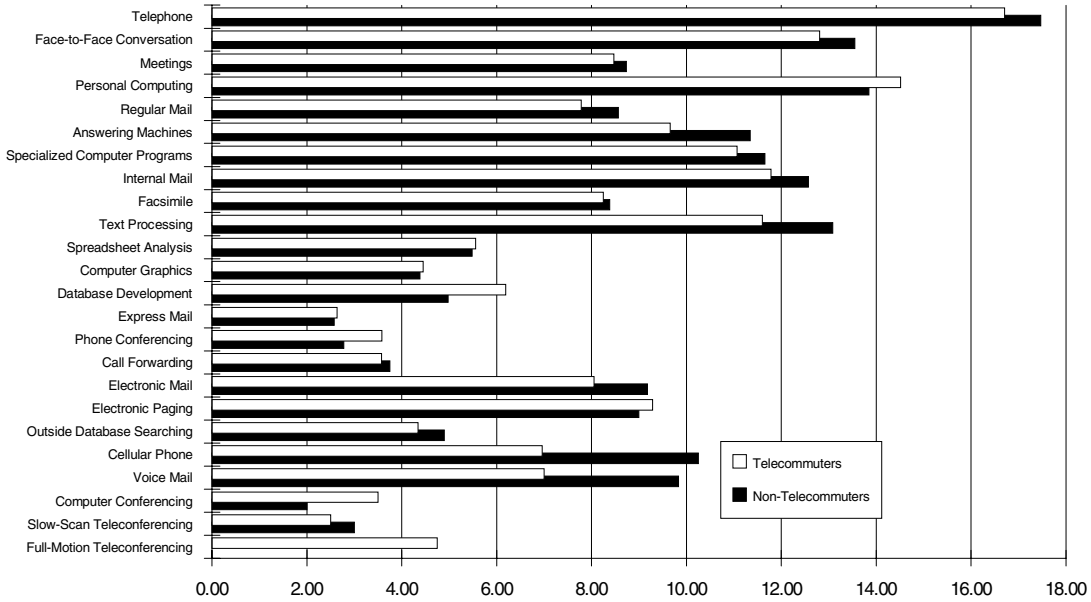
The leverage is computed only for those respondents who have the technology available to them. Therefore a technology that is not widely available can still appear as having high leverage if those few people who use it feel that it is important. Table 10 shows the rankings.

Although there are differences between the telecommuters and the members of the control group, none of the differences now appears to be statistically significant.[23]

It is noteworthy that personal computing ranks a close second in importance to the telephone for both groups, with text processing and internal mail alternating for fourth and fifth place. Although face-to-face conversation comes in third in both groups, it (and the telephone!) may be less important to the telecommuters than to the non-telecommuters. Figure 6 shows these results in graphical form. This leads us to conclude that personal computers, although not necessary for every job, have grown in importance for most City employees, whether or not they are telecommuters. Note that meetings occupy ninth place in importance for the telecommuters and twelfth place for the non-telecommuters.

[23]The idea of statistically significant differences between groups reflects two factors: size of each group and the differences in their means and variances. Two small groups, with a difference in means comparable to, or larger than, that of a pair of larger groups, may not show that difference as being statistically significant because the expected variance of a smaller group is higher. There were statistically significant differences between the two groups in the baseline and mid-term surveys.

Figure 6: Relative Leverages of Various Technologies



Voice mail, although not perceived as available to many participants, ranks higher than some of the computer capabilities in its leverage. On the other hand, some of the often touted "musts" for widespread telecommuting, such as computer, video and telephone conferencing, score near the bottom of the leverage scale. Full motion video conferencing is the most important of the three for those telecommuters who are aware of it or who have used it. However, most City employees are unfamiliar with either of these teleconferencing technologies.

One interesting relationship that shows up in the non-telecommuter group is the growing importance of electronic mail (computer-based messaging) to telecommuters. In our baseline survey, the non-telecommuters felt that electronic mail was significantly more important, by almost a factor of five, than did the telecommuters. By the mid-term survey, the ratio of perceived importance had diminished to 1.5. It slipped to 1.1 by the final survey. The difference between the two groups was statistically significant at the 0.0002 level[24] for the baseline survey, but was significant only at the 0.0994 and 0.6117 levels in the mid-term and final surveys, respectively. In our opinion this, reflects considerable convergence in attitude of the two groups as they increased in size and diversity, and in knowledge and

[24]That is, the probability is 0.0002 that the difference between the two groups is meaningless. To put it another way: the odds are 4999 to 1 against the difference being meaningless. By the mid-term survey, the odds against the difference being meaningless were reduced to 9 to 1. By the final survey, the odds had fallen to 0.6 to 1.

experience of electronic mail. We repeat our baseline forecast that electronic mail grows to be of comparable importance to the telecommuters as, and if, they gain experience with it.

Personal Investments

Ninety-six (62%) of the 156 telecommuters who responded to the final survey had made some sort of investment in work-related hardware and/or software during the past year. Of these investors, the average spent $2200 in computer hardware, of which $1800 was specifically for telecommuting. Software purchases accounted for $552, on average, of which $338 was telecommuting-specific. Maintenance costs accounted for $161 and $76, respectively; furniture costs averaged $385 and $253; and office machines took $775 and $353, respectively. Extra telephone services averaged $118, of which $88 was telecommuting-specific for 27 of the telecommuters. Total investments ranged from $5 to almost $15,000, with an average of just over $1400. Telecommuting-specific investments ranged from $10 to almost $8500, with an average of $668.

Part 2: Potential Impacts

The fundamental goal of the project was to demonstrate a method for reducing traffic congestion and improving air quality. That goal has been met. The next question is: what could be the long term impacts of telecommuting?

Impacts Explored

We have examined these issues at both the local —City of Los Angeles government — and regional levels. The examination included economic and energy issues as well as the air quality and traffic impacts. As part of the area-wide investigation we have developed a set of forecasts of the range of impacts likely to be produced by the expansion of telecommuting in the Los Angeles Consolidated Metropolitan Statistical Area (CMSA) comprising Los Angeles, Orange, Riverside, San Bernardino and Ventura counties.

City Employees Impact Assumptions

The group of City employees most likely to be directly affected by telecommuting comprises the 15,934 we have identified as prospective telecommuters. Telecommuting will indirectly affect all 45,000+ City employees. One key question is: although we have identified almost 16,000 City jobs that are likely to be telecommutable, how many will really work out to be so in practice?

To help assess that issue, we repeatedly asked the participants in the project — both telecommuters and telemanagers — to estimate how many of their co-workers could reasonably be expected to telecommute under the technology and work rule conditions of the project (that is, largely home-based telecommuting with do-it-yourself computer support). The requests were made both informally, during the focus group sessions, and formally, during the final questionnaire round.

The informal responses by the supervisors, in a group setting, tended to run around 50%. These estimates were strengthened by the formal questionnaires, in which the average response was also 50%, with the upper quartile starting at 75%. The telecommuters informal and formal responses also tended to match, although the telecommuters' estimates were higher: about 60% as the average reply, but with 42% of the telecommuters saying (in the final questionnaire) that almost all of their colleagues could telecommute at least two days per month.

In the following set of estimates we are assuming that *all* of the identified job classifications are telecommutable, either from home or from a satellite telework center. These estimates are based on the nature of the work required for each particular classification.

However, even if the job allows it, individual characteristics and desires may preclude telecommuting for some people. Therefore, we also assumed that there will be individual differences in telecommuting rates — including some individuals who will not telecommute at all. The latter group may be as high as 50% for some job types. The telecommuting rates used for the estimates are thus composite rates, based on the combined assumptions that some people will not telecommute at all; others will only telecommute from satellite centers; still others will only telecommute from home; some will do both.

The only way to estimate the City (or the regional) impacts more accurately is to continue evaluation of the experiences of an expanding number and types of telecommuters. Meanwhile, most of the estimates below for City employees are made for the assumption that most telecommuting will be from home or will be to telework centers that are close enough to home so that the telecommuters will not drive their cars to the centers. This situation may take several years to develop. Hence the estimates should be considered as goals to be reached by the year 2000, rather than immediate objectives.

Regional Impact Assumptions

The following scenarios for the impact of telecommuting on the Los Angeles CMSA are all based on a common set of assumptions about the basic population of the area and size of the work force. Table 11 shows the basic set.

These figures are derived from census data, our own surveys[25] and analyses of the composition of the work force.

[25]Surveys of State of California and City of Los Angeles information employees.

All of this is incorporated in a mathematical model that was originally developed by JALA in the late 1970's and has been refined several times since. The model includes more than 25 independent variables, describing the many factors associated with the changes in acceptance of telecommuting.

Each of these factors can change in value from year to year. For example, the fraction of the total work force that comprises information workers slowly increases over the 1992 to 2030 period. So, too, do the commuter modal selections; distribution of passengers between single occupant cars and higher occupancy vehicles; energy efficiencies of the vehicles; and the various factors in telecommuting (distribution between full-time home-based to full-time telework center-based; average hours per week telecommuting; full-commute and telework center commute distances).

Table 11: Los Angeles CMSA Impact Assumptions

Total population:	15,187,000
Population annual growth rate	2.346%
Total area work force:	6,828,000
Total information workers:	3,988,000
Commuters	6,691,000
Commuters using private vehicles (including car/van pools):	90.4%
Commuters using mass transit:	8.6%
Average information worker daily commute (round-trip miles):	39

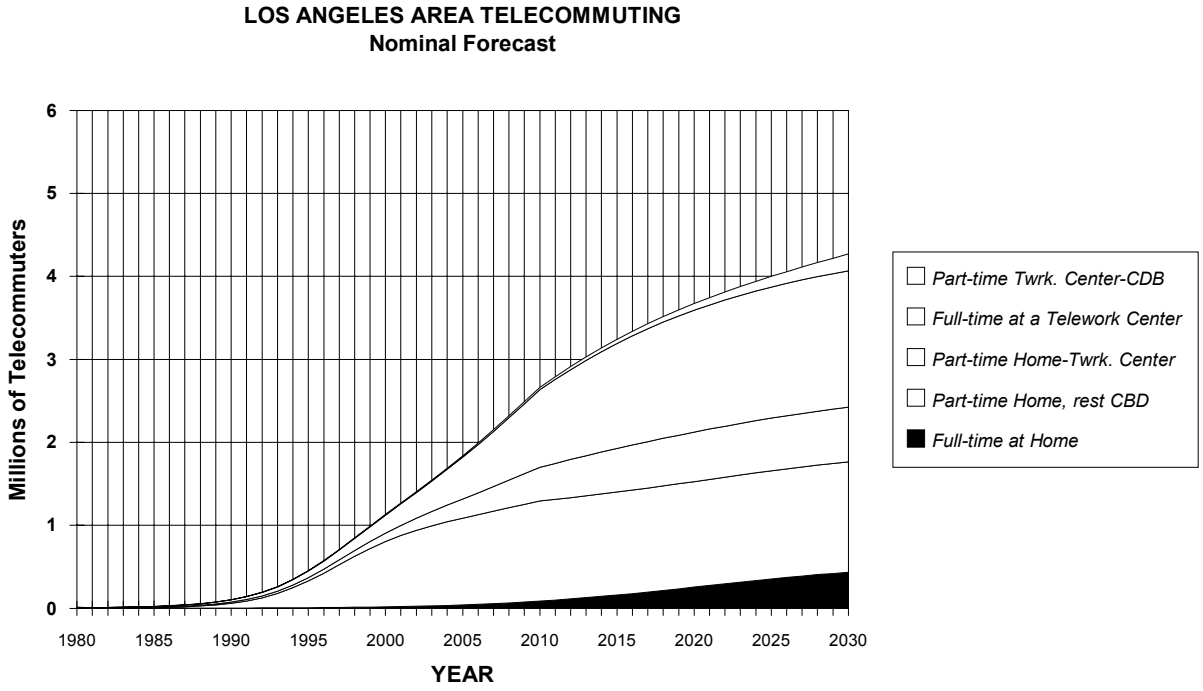
Both of the scenarios include several independent trend estimates. For example, automobile fuel efficiency is assumed to increase at a rate comparable to EPA total fleet standards. The number of telecommuting hours per week increases with time. The average distance to telework centers decreases as the assumed number of center increases. Nevertheless, as population grows, so does traffic congestion (and commute times) together with average commute distance.

Baseline Scenario

Figure 7 shows the distribution in the five major variants of telecommuting for the nominal model.

This scenario estimates that the five-county area has 194,000 telecommuters of all sorts by the end of 1992. Most of these (144,000) work part time at home, typically less than 1.25 days per week. The rest either work full-time at home (about 5,000) or at a regional center of some sort. When one considers that the governments of the City and County of Los Angeles jointly have more than 2,000 known telecommuters, and that the area total includes university professors, writers, etc., this seems to be a reasonable figure.

Figure 7: Nominal Telecommuting Forecast.



One of the problems with estimating the real extent of an innovation at an early stage is that of counting what is a sparse population component; 1.3% of the population in this case. As the number of telecommuters grows, and particularly as the number of formal telecommuting programs increases among area employers, it will be easier to get more exact numbers of the actual growth.

High Growth Scenario

The high growth scenario assumes that the "normal" rate of growth of telecommuting is boosted by a combination of regulatory and competitive pressures, improvements in technology and consequent attitude changes on the part of potential adopters. Figure 8 shows the results of that analysis.

Table 12: Growth Limits by Form of Telecommuting

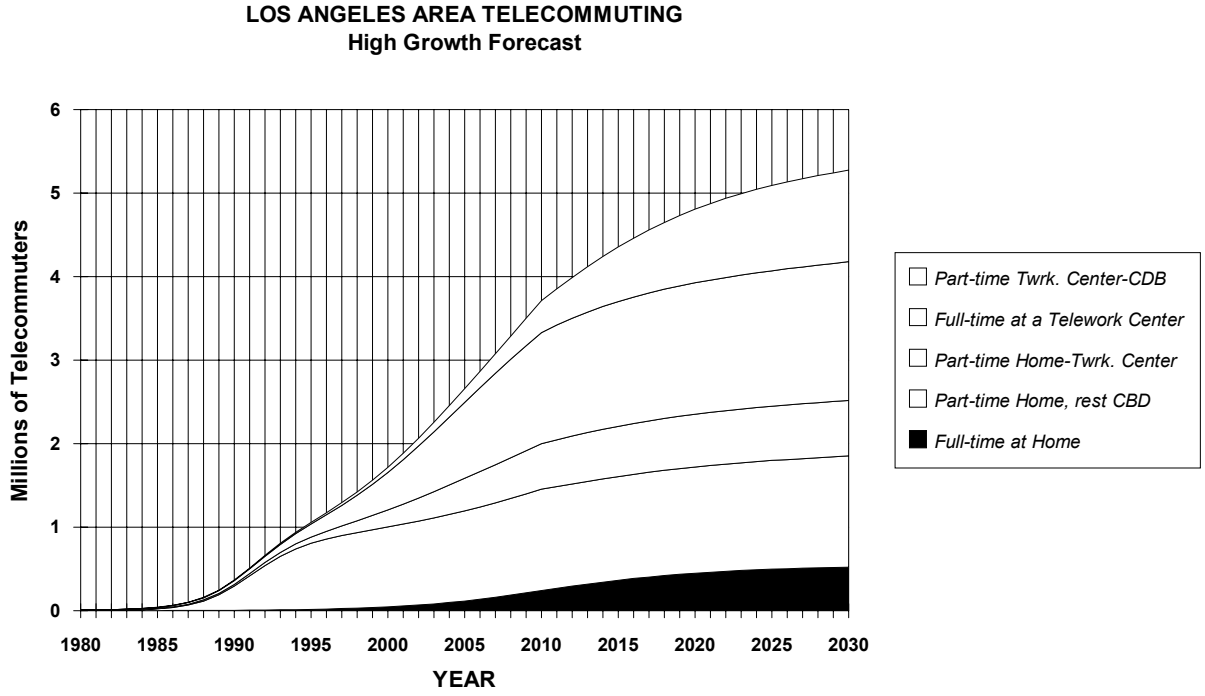
Type of Telecommuting	Maximum % of Infoworkers
Full-time home	8
Part-time home/CBD	20
Part-time home/LC	10
Part-time LC/CBD	17
Full-time local center	25

As a check to the validity of the scenario, the 1992 State of the Commute report from CTS reports that 9.1% of its survey respondents claimed that they worked at home an average of four days per month. This amounts to 619,000 home-based telecommuters in the region. The High Growth

Scenario of Figure 8 gives a value of 663,000 telecommuters of all types for 1992, comparable to the CTS estimate. If the CTS survey is correct, the region is at present near the high growth scenario.

Both scenarios have the same assumptions as to the ultimate limits of telecommuting. That is, both assume that telecommuting will peak at 80% of the information workforce, sometime in the mid-21st century. The scenarios also include the same assumptions about the distribution of modes of telecommuting. Table 12 shows the assumptions. The term *CBD* in the table refers to Central Business

Figure 8: High Growth Scenario



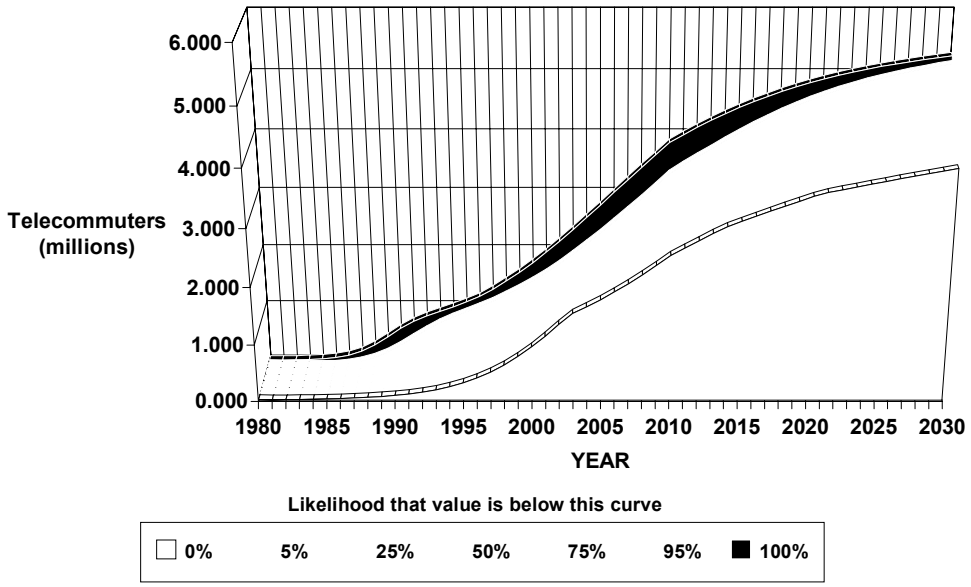
District. In this context it simply means the "traditional" office center where the telecommuter would be working otherwise. Similarly, *LC* refers to any one of the forms of regional telework center mentioned earlier. Both scenarios also assume a decreasing distance to the local center over the years, as the number of centers increases.

The Scenario Spectrum

These nominal and high growth scenarios generally cover the upper and lower limits of telecommuting in the region, as estimated by our demographic and economic analyses. Neither of these scenarios will actually unfold exactly as shown here. Reality is always different from long term forecasts.

To get an idea of the range of possibilities we performed what is known as a Monte Carlo analysis of the scenarios. For this process, we estimated the likelihood of the various rates of growth of each of the five types of telecommuting, providing a probability distribution function for each. We then ran 1000 scenarios, each time with a different combination of growth rate assumptions, as governed by the probability distributions.

Figure 9: Likelihood Distribution of Telecommuting Scenarios



The results of that analysis are shown in Figure 9. The graph shows the range in expected value of the total number of telecommuters for each of the years from 1980 to 2030. The lowest (0%) curve represents the minimum number of area telecommuters that we expect to see, while the top (100%) curve represents the maximum number we expect to see. the intermediate curves represent the probabilities that reality will be at or below that curve. The CTS survey value of 619,000 telecommuters for 1992 is at about the 85% likelihood point of the analysis. This, too, supports the conclusion that we are presently nearest to the high growth scenario.

Traffic Congestion and Air Quality

City Employees

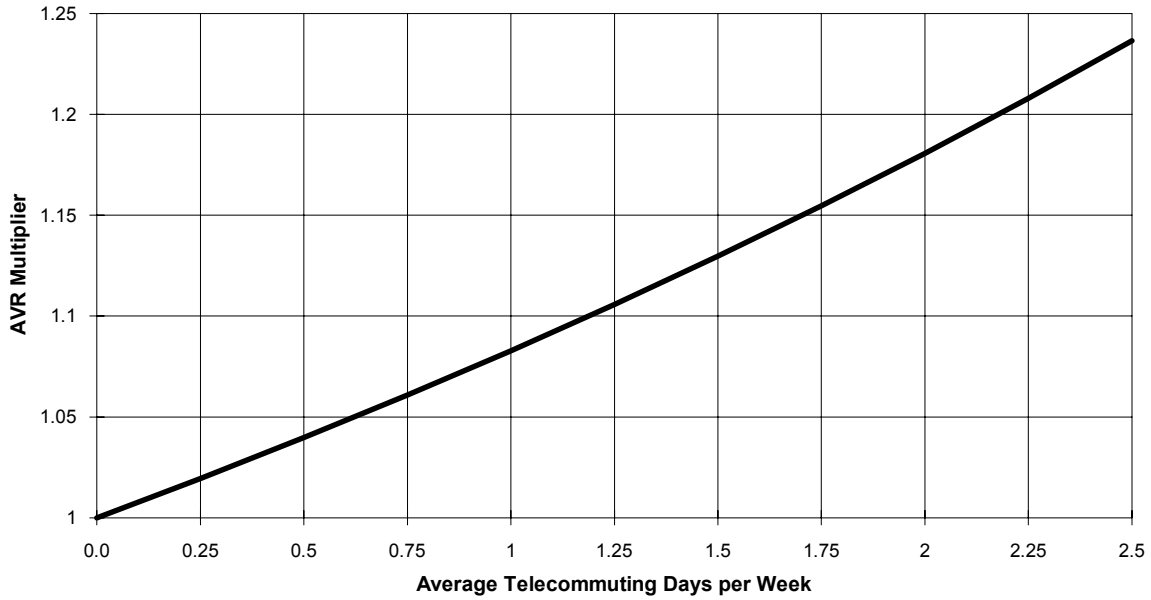
The City of Los Angeles has 49 sites that are subject to the requirements of Regulation XV. By far the most populous of these are in the Civic Center. Therefore our analysis has been made under the simplifying assumption that all of the

City's employees work in the Civic Center. Distances of a few blocks between sites have no appreciable effect on the results. The department-level computer model, developed as part of this project task, can be used to get more accurate estimates.

For purposes of the analysis, we assumed that City employee still have the ridesharing behavior evidenced by a survey completed by the City Administrative Office in 1991. In that survey, 29% of City employees were on compressed work schedules. Our analysis assumes that the 29% figure continues to hold and that the distribution of types of compressed schedules matches that of the final evaluation survey of the Telecommuting Project; that is, 91% using 9-80 and 7% using the 4-10 schedule.

If the City continues its pattern of ridesharing and compressed schedules, then what is the impact of telecommuting? The City has 49 facilities that are subject to the rules of Regulation XV. These are scattered throughout the City, but the primary concentrations of City employees are in or near the Los Angeles or the Van Nuys Civic Centers. The target Average Vehicle Ridership (AVR) rates for City facilities are either 1.5 or 1.75, with the 1.75s primarily in the Los Angeles Civic Center region.

Figure 10: Telecommuting AVR Multiplier Factor for the City

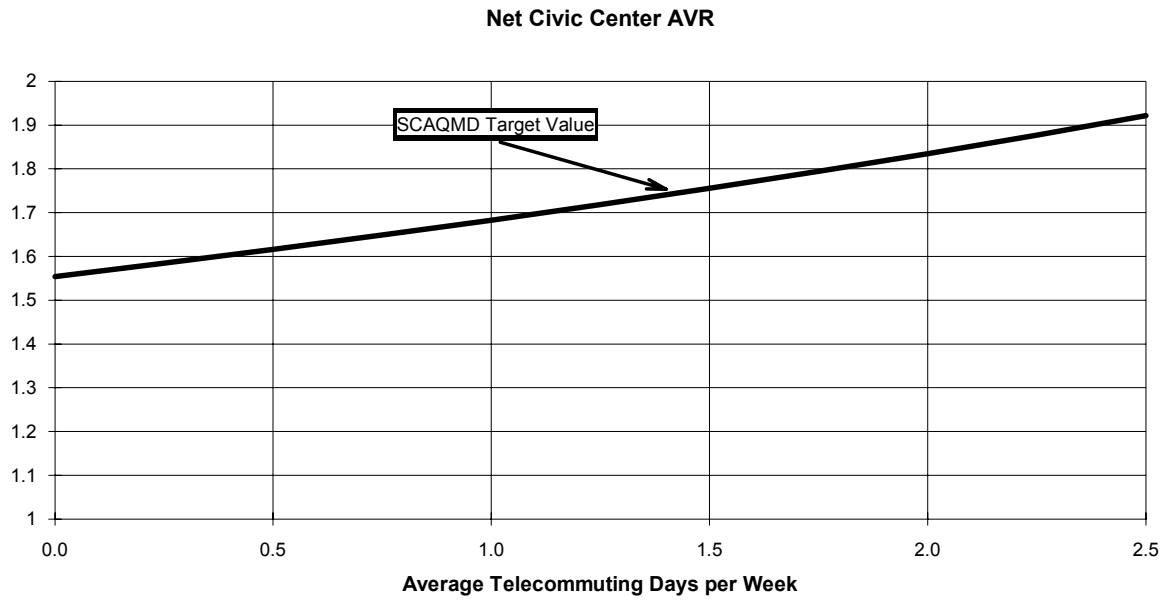


Our analysis indicates the impact of telecommuting on AVR by means of an AVR multiplication factor that is a function of the average level of telecommuting among its 15,934 potential telecommuters. If none of these employees telecommute, the multiplication factor is 1.0; that is, no effect (since 1.0 × the current AVR = the current AVR). If all of them were to telecommute 5 days per week — an

extremely unlikely situation, then the multiplication factor would increase by more than 60%. Figure 10 shows the relationship, with average telecommuting days per week ranging from 0 to 2.5.

Since the Civic Center area provides the most stringent case of the AVR target we can ask what amount of telecommuting would be required to increase the AVR from its 1992 level of 1.554 to the target level of 1.75. Figure 11 shows the relationships of Figure 10 applied to the current Civic Center AVR. As can be seen from the Figure, the AVR target would be met, without any other AVR-related changes, if the average level of telecommuting were increased to about 1.4 days per week. This is quite an attainable figure. Our analysis of City employee jobs gives an estimated average of 1.46 telecommuting days per week.

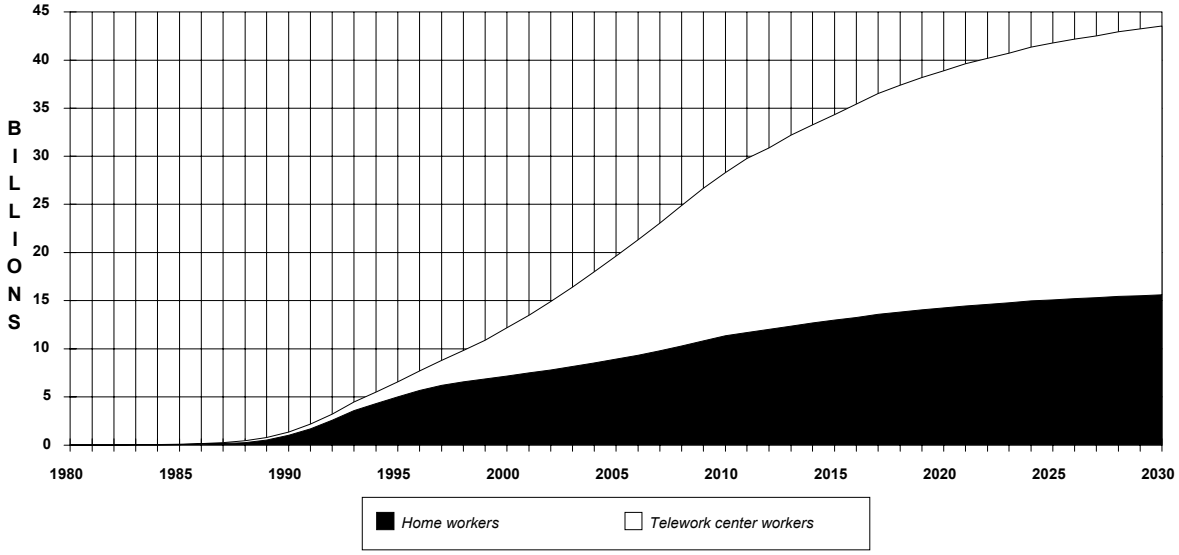
Figure 11: Telecommuting impacts on the Civic Center AVR



Note that, in this general model, we have assumed that the distribution of job types and commuting behaviors is the same at all City facilities. Of course, this is not the case; each facility has its own particular mix of jobs and commuting behaviors. The relationships of Figure 10 are to be used for estimation purposes only. For example, the achieved AVR at the Van Nuys Civic Center in 1992 was 1.107. Its AVR target is 1.5. The ratio of 1.5 to 1.107 is 1.355. From Figure 10 we see that a multiplication factor of 1.355 is off the scale. Actually, it would require an average of about 3.3 days per week telecommuting to meet the goal if no other changes occurred — and if the population distribution at the Van Nuys Civic Center matched that of City employees in general. This is more than double the requirement at the Los Angeles Civic Center and more

than double our, admittedly conservative, estimate of what can be expected from City employees in the next three or four years. If the model is applicable, it is clear that telecommuting alone cannot solve all the air quality improvement requirements; some combination of telecommuting, additional ridesharing and compressed work weeks seems to be required.

Figure 12: Annual Mileage Reductions from Telecommuting: High Growth Scenario



In any case, if the City were to have its 15,934 telecommuters working from home an average of 1.4 days per week, then the annual pollution reduction would be on the order of:

- 6,150,000 pounds of carbon monoxide;
- 380,000 pounds of nitrogen oxides;
- 1,150,000 pounds of unburned hydrocarbons; and
- 26,000 pounds of particulates.

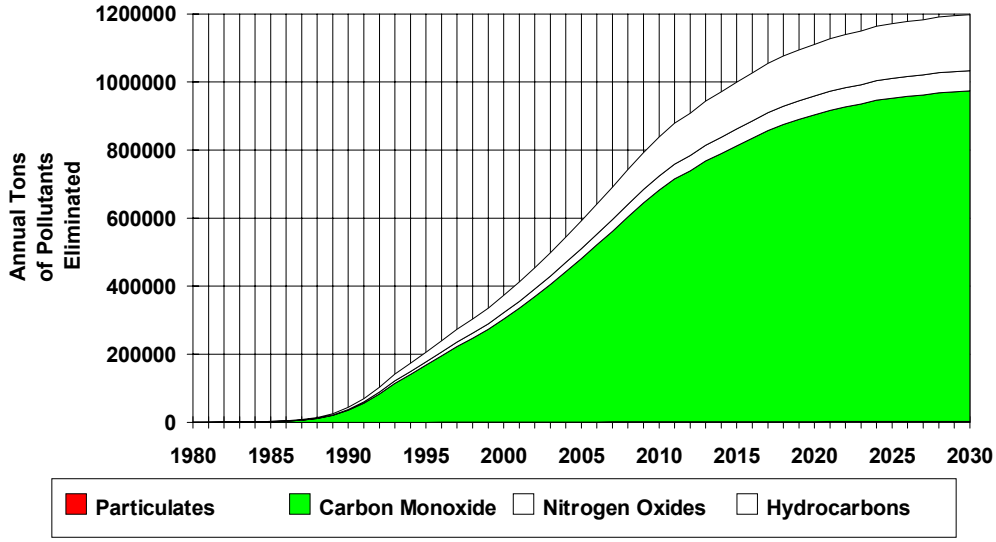
Area-Wide

Figure 12 shows the annual levels of reduced car mileage for the Los Angeles CMSA under the high growth scenario.

Since at least half of this mileage reduction involves automobile cold starts — the most polluting phase of car use — telecommuting promises to be a significant reducer of air pollution in coming years. Figure 13 shows the results for the high growth scenario. Since the pollution reduction data were calculated using a constant ratio of pollutants per vehicle-mile, the results are somewhat understated for the 1990s and, perhaps, overstated for the years past 2000. The early understatement is because the data used were for highway travel in the mid-1980s and did not include an increase in pollution for the startup and idling periods. An overstatement could result from a steady improvement, over the mid-1980s levels, in the quantity of pollutants emitted by cars.

For comparison, air pollution data from the South Coast Air Quality Management District show the annual pollution contribution from cars in 1991 to be 1,580,000 tons of carbon monoxide; 221,000 tons of hydrocarbons; 243,000 tons of nitrogen oxides; and 20,000 tons of particulates. If the high growth telecommuting scenario continues, we could expect a reduction by the year 2000 of 19%; 23%; 8%; and 4%, respectively, from present levels.

Figure 13: Air Pollution Reductions from Telecommuting: High Growth Scenario



Clearly, these air pollution reduction values provide a persuasive argument for further development of telecommuting. In addition to the air pollution factors, there are the energy conservation consequences of telecommuting. Our forecast model calculates the net effect of telecommuting on energy conservation. The net effect is derived from the reduction in automobile fuel use by telecommuters, combined with the possibly increased use of computers and the clearly increased use of telecommunications.

Economic Competitiveness

The key effects of pollution reduction, although the primary incentive for the City of Los Angeles Telecommuting Project, may be eclipsed by the economic impacts of telecommuting. The telecommuter effectiveness increase values we have obtained from the project can be considered typical of those in large organizations. In fact, we have tried to be conservative in every case. Therefore, these results may be generalized to the region as a whole without fear of overestimation, in our opinion.

Employee Effectiveness Changes

We estimated the likely change in work effectiveness that telecommuting would produce for each of the City telecommuting-appropriate job classifications.[26] As in the case of the estimates for the *amount* of telecommuting for a particular classification, the *effectiveness change* estimates are made on a combination of experience gained in the City of Los Angeles Telecommuting Project and from similar projects elsewhere.

The changes are expressed both as an average expected effectiveness improvement and as a total dollar impact for each evaluated classification, using 1992 salaries as the basis. The overall average estimated effectiveness change is 10.7%. **If all of these telecommuters were to perform exactly according to the estimates, the net result would be an annual effectiveness impact of $75,794,175** (constant 1992 dollars) or more than $93 million by 1998, assuming average salary escalation of 4.3%.

Whether, and in what form, these impacts would be realized is beyond the scope of this project since it involves a number of key management issues. Foremost among them is the ability of an organizational unit to assimilate the improvements. That is, does an individual's effectiveness increase translate directly into a comparable increase in the effectiveness of the organization in which the individual works — is the effectiveness change used properly? If so, there are two classical first-order options for the organization:

1. Increase the level of services provided by the unit without increasing the number of personnel in the unit. A variant of this is the diversion of expansion funding to technology improvements (such as computers, networks, telecommunications and/or peripheral equipment) rather than to salaries for more employees.

2. Decrease the number of personnel in the unit without changing the level of services. The current euphemism for this is downsizing.

Each of these options must be examined very carefully as part of the management response to the impacts of telecommuting. However, for many of the units we observed during the project, the most logical option is the first; at least some of these units are currently severely

[26]For details, see the *Department Impact Modeling Report*.

overloaded and telecommuting is allowing them to function at the desired level with their existing staffing.

However the effectiveness impacts are applied, the economic arguments for telecommuting seem quite powerful.

Net City Economic Benefits

Employee effectiveness increases are not the only impacts of telecommuting. There are additional savings in office and parking space, reduced turnover rates and decreased use of sick leave. We have evaluated these total impacts in a series of three alternative scenarios:

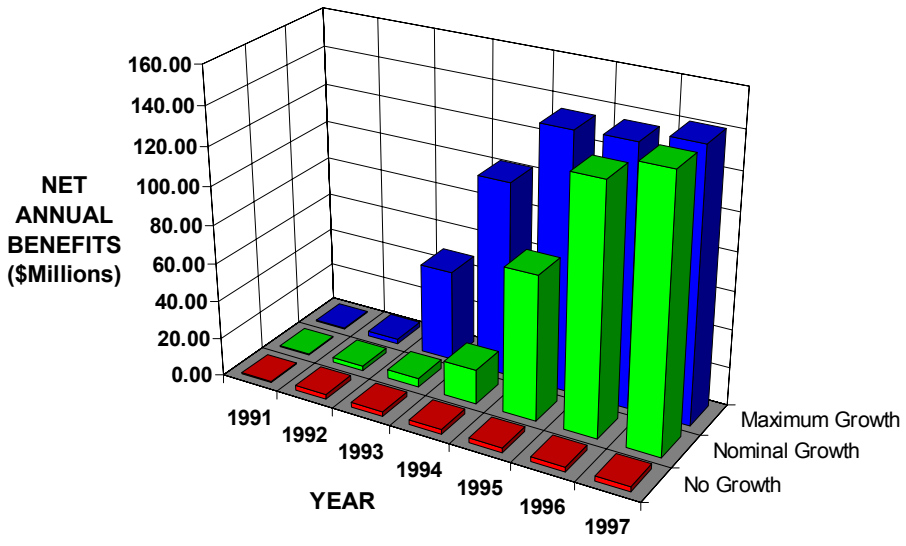
- In the first scenario, the use of telecommuting by the City remains at its current level.
- The second scenario shows a steady growth, beginning in 1993, to the maximum expected number of 15,934 City telecommuters.
- The third scenario shows a more rapid growth rate to the maximum.

The analysis includes estimates of the costs of training and technology improvements required to produce the growth. The net benefits to the City are shown in Figure 14.

Area-Wide

The City of Los Angeles Telecommuting Project and all other well-conceived and organized telecommuting activities show a consistent common economic result: the effectiveness of telecommuters is higher than that of non-telecommuters. Our measures indicate an improvement on the order of 9.3% for the entire group of prospective City telecommuters. Our experience with other organizations in California, both public and private, lead us to expect some

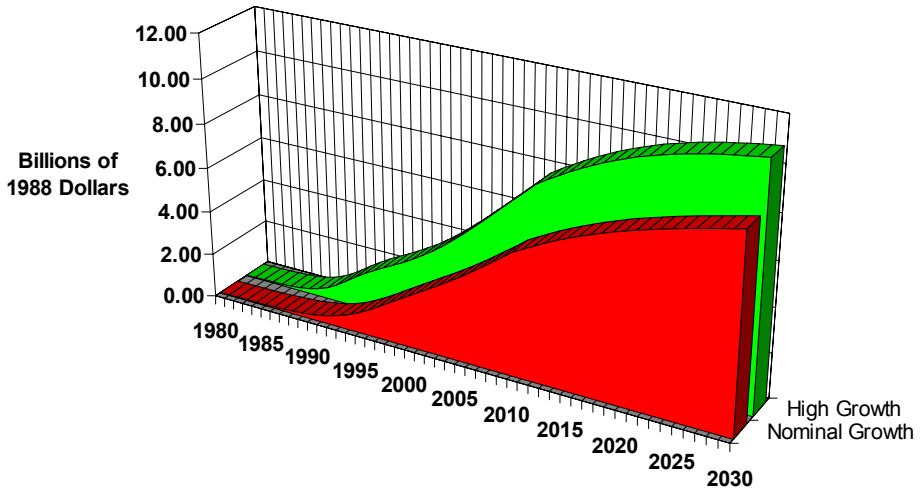
Figure 14: Net Telecommuting Benefits to the City



organizations' averages to be as much as double the City of Los Angeles values. Nevertheless, if we take the conservative approach and use the City's effectiveness changes as typical of the region, then the direct of effect of telecommuting in the area could be as shown in Figure 15.

The direct economic impact of the effectiveness changes in the year 2000 ranges from at least 2.3 billion to as much as 3.5 billion dollars annually, depending on the scenario the future most resembles. These figures are in constant, 1988 dollars and are based on the area's 1988 per capita salary income. Since information workers — or at least those who are likely to be telecommuters — are more likely to have higher than average salaries, the information in Figure 15 are likely to be doubly understated.

Figure 15: Area-Wide Effectiveness Change Impact of Telecommuting



In addition to the direct effect of telecommuting, the indirect impacts must also be considered. At the microeconomics level, if organizational effectiveness improves, so does the organization's profitability. The organization is better able to compete, both by reducing the costs of its existing goods and/or services and by offering new goods and/or services. Both of these goals are achieved by reducing the person-hours required to produce a unit of output (in these cases, units of information). If the organization is in an expanding market, the newly released person-hours can be used to increase or improve product.

At the macroeconomics level, widespread improvements in competitiveness of individual organizations act to increase economic growth in the region in general. Thus, the overall impact is likely to be some multiple of the direct impacts

shown in the figure. We estimate that the actual impacts could be as high as five times the values shown in Figure 15. That is, in the year 2000, telecommuting could be associated with a 10 billion dollar improvement in the region's economy, compared to what it might be with no telecommuting.

Finally, it is important to consider another, potentially major, "side effect" of telecommuting: its ability to bring work to workers who cannot easily go to a traditional workplace. The 1992 riots demonstrated the consequences of a long standing economic dysfunction in Los Angeles: no jobs for a large component of the population. Among the plethora of rationalizations about the fundamental causes of the riots there is one constant: many people feel that they are trapped in a dead end existence. They feel that they have no access to, or hope of, means to improve their condition. Frustration, rage and eventual destruction are the natural consequences of that situation. What to do?

Telecommuting provides one approach to resolution of that problem. First, work can be sent to any residents who are mobility handicapped, either because of physical impairments or the lack of adequate transportation. Second, work can be combined with training (or vice versa), so that worker skills, from basic reading ability to more complex information skills, can be upgraded while the trainees are working. The information tools to accomplish this are here today and are growing in capability daily.

One strategy to develop this capability is through the development of neighborhood business centers that combine "regular" small business operations with telework/training centers.[27] This would promote a system of positive cash flow into the community from the inception of the center(s). Variants of this model have shown themselves to be successful both elsewhere in California and in Europe. As a first step, the Los Angeles County Transportation Commission has plans to initiate one or more centers in South Central Los Angeles in conjunction with its Blue Line stations. Each center would be linked to others via the fiber optics transmission system that is a part of the light rail network.

It is difficult to put a figure on the value of such centers. One success criterion would be that they are at least self supporting and turn out employees who are qualified to work in skilled jobs. If that is the case, then there is a clear economic benefit. If the local economy improves as a direct

[27]The author, in concert with CHARO, attempted to initiate such a center in East Los Angeles in the mid-1980s, but an impasse with a large corporation, regarding facilities sharing, stifled the project.

result of such activities, then the overall benefit can be substantial.

Over 800,000 Americans information workers are disabled every year. Although we were not able to get exact figures, presumably about 42,000 of those newly disabled information workers live in the five counties area. Some fraction of those workers are perfectly able to do useful work, provided the work can come to them at least some of the time. Each worker who returns to the work force instead of receiving benefit income makes a double contribution to the economy. If telecommuting could produce a 10% reduction in the number of newly disabled individuals who were otherwise able to work, then the additional annual impact could be on the order of 200 million dollars.

Energy Use

Like the traffic, pollution and economic impact aspects, the experience of the City's Telecommuting Project in energy conservation can be generalized to both the rest of the City employees and to the region as a whole.

City Employees

Our forecast of the overall energy conservation impacts is based on an analysis of the commuting patterns of all City employees. This estimate is derived from data supplied from the Department of Transportation as a result of their 1990 survey of City employees. Although commute distances were not included in the survey, we were able to estimate them for about 18,000 of the 30,500 employees in the survey[28] on the basis of the ZIP codes for each employee's home and office. The average estimated one-way commute distance for these employees was19.8 miles, slightly less than that of the telecommuters in the project.

We also assumed that future telecommuters would have the same pattern of compressed schedules as were revealed in a survey conducted by the City Administrative Office in 1991. This produces an average effective work week of 4.84 days. The telecommuting rate was assumed to be an average of 1.4 days per week; sufficient to meet the Civic Center AVR requirements.

The calculations produced an average annual energy saving of 4198 kilowatt-hours per telecommuter, for a total annual saving, assuming all 15,934 telecommuters are active, of 59.9 million kilowatt-hours, about 1,600,000 gallons of gasoline.

Area-Wide

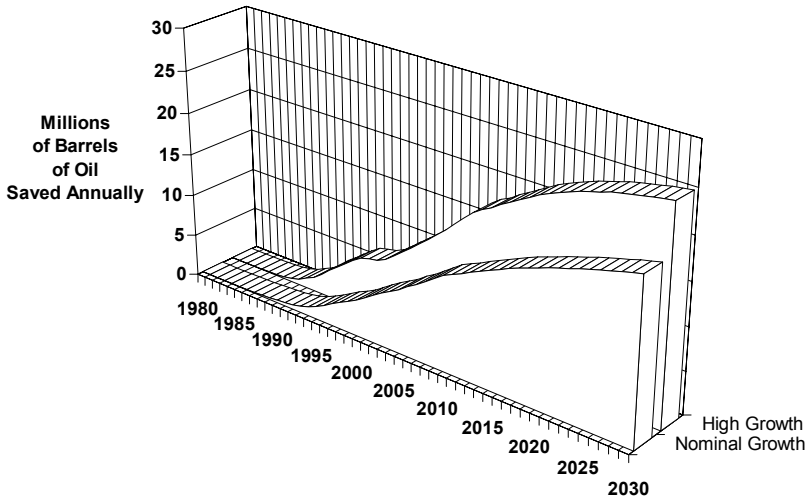
Our forecast model calculates the net effect of telecommuting on energy conservation. The net effect is derived from the reduction in automobile fuel use by

[28]The reamaining employee entries in the database either had missing or faulty entries for one or more of the ZIP codess.

telecommuters, partially offset by the possibly increased use of computers and the clearly increased use of telecommunications.

Two factors are not included in the model. First, notwithstanding the contrary experience of the City project, we expect that telecommuters will tend to use slightly more home heating and cooling energy while they are telecommuting. At present, there are no data to show an offset of this energy use by a comparable reduction in the heating and cooling of the "downtown" offices of the telecommuters — largely because there are not yet enough telecommuters for the effects to be noticeable. The model assume a wash between these two energy uses in the long run.

Figure 16: Estimated Area-Wide Energy Conservation Impacts of Telecommuting.



Second, the model does not include our finding that about 20% of telecommuter households have a reduction in car use over and above the telecommuting-specific reduction.[29] Given these caveats, we feel that the projections shown in Figure 16 provide a conservative estimate of telecommuting's energy impacts.

Neighborhoods and Regional Structure

One of the perceptions about most large cities is that their citizens suffer/enjoy a large degree of isolation. This is particularly true of so-called bedroom communities, where a large fraction of the resident population travels to somewhere else for nine or more hours every weekday. By

[29] See our report: *Telecommuting Travel Impact Analysis: Los Angeles Telecommuting Pilot Project* for details.

some quirk of Murphy's Law it often appears that people who live on the west side of Los Angeles (or insert the name of any other city in the region) drive to work on the east side . . . and vice versa and so on.

One of the aspects of moving the work to the workers instead of moving the workers to work is that the workers are not doing the locale swap as often; they are spending more time in the areas in which they reside. Our research and that of others indicates that telecommuters, when they do travel to other than their principal offices, are more likely to make trips to nearby locations than are non-telecommuters. That is, the telecommuters are becoming more locally or community oriented. This can have a number of interesting impacts. We have only preliminary data on these effects, since they are somewhat dependent on the number of telecommuters and many of the effects can take several years to develop.

First, if more people are around the neighborhood on ordinary week days, what is the effect on the crime rate? One possibility is that programs such as Neighborhood Watch may be more successful; there are more neighbors to watch. If telecommuters, who are more likely than average to use electronic mail, start to set up neighborhood electronic alert networks, Neighborhood Watch takes on a new dimension. Yet, if telecommuters are busy concentrating on their work all the time, the effect may be negligible. Our experience is that telecommuters become more neighborhood aware even if they do not become more active in neighborhood activities.

Second, if telecommuters spend more time in the local area, they are more likely to do business with local businesses — at the expense of the businesses near their downtown offices. However, they are less likely to go out to lunch, so the lunch time restaurant business may show little change locally and a decrease at the downtown location. On the other hand, they may be more likely to go to a local restaurant for dinner — with the family.

The net result of this may be that neighborhoods with moderate to large numbers of telecommuters will become more cohesive: neighborhoods after the small, cohesive community style. This cohesion could further increase community emphasis on and participation in education and other activities usually identified with such well-functioning communities.

At the same time, the telecommuters are likely to maintain contacts with co-workers and friends who may be scattered all over the region, or all over the world, for that matter. Thus, they will have the advantages of essentially global job and interest/avocation diversity, while maintaining roots in a local community. While it is difficult to see clear

indications of this at this time, there are clues to the trends. The clues are appearing in such statistics as the growing difficulties employers are having in getting their employees to move to other locales[30], and the growing popularity of such computer-based information services as Prodigy™ and CompuServe™.

The desired effect of telecommuting is to help redress the jobs-housing imbalance. That is, to allow existing businesses and employees to be located where they are now without incurring the travel that currently occurs. There is a potential undesirable side effect of telecommuting: the telecommunications equivalent of the "freeway effect." That is, the mere existence of the ability to move to almost anywhere, while still being able to hold a properly paying job, may cause people to flock to new areas with lower housing costs — urban sprawl. To quote from an earlier publication:[31]

> The process as new highways are completed, for example, runs roughly as follows in regions of economic attractiveness:
>
> 1. The improved transportation infrastructure is a major inducement for businesses and households to move to areas that are both served by the infrastructure and have lower land prices. The goal in individual household move decisions is to achieve an attractive, affordable, generally low population density residence location.
>
> 2. The expanded movement to the newly developing area acts to increase land prices and congestion, increasing population density (and decreasing step 1 attractiveness) as population growth continues in the area.
>
> 3. The increasing congestion and improving tax base spur demand for further expansion of the transportation infrastructure either by increasing capacity, often at the expense of removal of local residences, or by extending the infrastructure to more rural areas, or both. Go to step 1.
>
> Continuing repetition of this cycle ultimately results in the wide scale suburbanization of the area and elimination of formerly rural areas. Often these areas were originally forested, agricultural or wildlife habitat land. Los Angeles is often cited as the archetypal example of this process.

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[30] As reported in such publications as *Business Week* and *The Wall Street Journal*. The employees do not want to break up their children's school work and friendships or, in the millions of multiple earner families, jeopardize their spouse's jobs.

[31] Jack M. Nilles. Telecommuting and urban sprawl: mitigator or inciter? *Transportation* **18**: 411-432, 1991

In the telecommuting case, the existence of a telecommunications infrastructure, which could be wireless, could result in the demand for an expanded transportation infrastructure and increasing conversion of rural land to housing and its related physical infrastructure. We have seen no evidence of this, but the possibilities must be considered in any comprehensive regional plan.

Part 3: Recommendations

The author makes the following recommendations to the City for addressing the issues raised in this report.

Immediate Action

The first three recommendations apply for all circumstances.

- **Increase the level of awareness of upper departmental management** concerning the impacts of telecommuting. This can begin with distribution of report summaries and/or high level briefings to all department General Managers. This was our recommendation after both rounds of focus group meetings and it continues to be because it is so critical to the success of telecommuting.
- **Maintain at least the current level of telecommuting and, at a minimum, begin expanding telecommuting** in those departments that already have active telecommuters.
- **Develop uniform telecommuting guidelines**. The project began with the development of a tentative set of guidelines that were provided to all departments as part of the training program. While they proved to be quite serviceable during the project, the guidelines often were interpreted differently by different departments. A revised set of guidelines would address the issues raised during the project. Appendix 1 provides a suggested set of rules.

Internal Implementation Priorities

The subsequent recommendations are made under the assumption that telecommuting will continue in the departments currently participating in the project.

Management

- **Integrate Transportation Demand Management Strategies**. Telecommuting has proven itself to be an

effective rideshare strategy. Promotion and expansion of telecommuting should be a formal part of an integrated strategy for managing the use of transportation by City employees.

- **Create Specific Incentives and Disincentives**. Although the project has been successful, it is abundantly clear that there is still significant resistance to telecommuting — not to mention downright hostility — on the part of many City managers. In addition to the expanded awareness program listed earlier, a system of incentives (recognition, factors in promotion/salary decisions, etc.) and disincentives (such as minimum telecommuting quotas) should be devised to overcome that resistance.
- **Expand Telecommuting**. The results of the project clearly indicate that the use of telecommuting should be expanded. Our analysis suggests that at least 15,934 City employees — one-third of the City's permanent staff — could successfully telecommute.
- **Increase and Expand Training**. It is also clear that training in the management methods of successful telecommuting is important to telecommuting's success. Both initial, pre-telecommuting training and follow-up reinforcement are called for. All of the City's telecommuters and telemanagers should receive training. Further, the training should include:
  1) managers who are not currently (but may become) direct supervisors of telecommuters; and
  2) colleagues of telecommuters.
- **Develop TeleService Program**. The City has already developed regional City Halls in Van Nuys and West Los Angeles. Telecommuting could be used to further distribute City services all over the City. This may be of particular importance in areas affected by the recent riots. Mini- or micro-City Halls could be developed, staffed by telecommuters living locally, to provide most City services to local residents.

Technology

- **Form a City-wide action committee, possibly as a subcommittee of the Telecommuting Task Force**, to define and resolve the issues of technology performance and reliability standards; technology needs and applicability for various types of telecommuting work; and ownership and financing possibilities.
- **Improve Access to Information Technology**. There is no question that access to personal computers is a major factor in improving effectiveness of City information workers, whether or not they are telecommuters. A number of telecommuting-trained

City employees were prevented from participating in the project because they didn't have personal computers at home or were unable to get access to the City's mainframe computer. Our focus group sessions and personal interviews indicated many cases where City employees have invested their own funds in computer equipment that is superior in performance to that in their principal office. It appears that the City is incurring major opportunity costs because of the freeze on computer equipment. It is extremely important that this issue be resolved soon.

- **Resolve the uncertainties about mainframe access** for those prospective, trained telecommuters who have not yet begun to telecommute[32]. This was our recommendation after each round of focus group meetings and continues to be because it still an outstanding issue.
- **Develop a uniform, City-wide policy**, possibly in conjunction with vendors, on duplication of applications software used by telecommuters at home.
- Although voice mail is now available (500 "mailboxes"), most telecommuters are not aware of it. **Broaden the awareness of, and access to, voice mail**, particularly for telecommuters.
- **Increase audio/telephone (and, where appropriate, video) teleconferencing capabilities and awareness** in each department as a means of increasing "attendance" at meetings without increasing travel for meetings.

Provide Area-wide Leadership.

There are many ways in which the City can show leadership in Southern California. The following are examples.

- **Publicize the results of the City of Los Angeles Telecommuting Project** to other cities and to area businesses.
- **Revise zoning ordinances** to encourage telecommuting (while discouraging potential urban sprawl made possible by telecommuting).
- **Cooperate with other Cities and public agencies to share facilities** for telecommuters so that public sector employees all over the region can begin telecommuting from offices near their homes.

[32]Only about half of the individuals trained by JALA were allowed to telecommute.

Part 4: A Brief Action Plan

Telecommuting Implementation Group

The planning phase and the first stages of implementation of the Telecommuting Pilot Project were initiated by the Telecommuting Task Force (TTF). The TTF comprised senior managers from several City departments. The purpose of the TTF was to provide general policy guidance to the project, but it was not closely linked to the details of the implementation. Nor was the TTF an advocate of telecommuting, other than to support its testing. It was deliberately neutral.

Assuming our recommendation for expansion of telecommuting is adopted, we further recommend that the first step in the expansion process is the appointment by the Mayor of a proactive Telecommuting Implementation Group (TIG) whose primary task is to ***motivate*** **and coordinate** the expansion process. This is a quite different mission from that of the TTF. The State of California formed a Telecommuting Advisory Group with a mission similar to that suggested here. The effectiveness of that group is demonstrated by the fact that the Governor decreed that telecommuting is a key work option for State employees and that the number of State telecommuters has more than quintupled since the Pilot Project was completed in mid-1990.

Members of the TIG should be senior managers from every department of the City that has, or is likely to have, active telecommuters. The TIG should also include representatives from all of the affected unions. The Chairperson of the group should be someone who is directly concerned, because of the nature of his/her job, with traffic reduction or with productivity improvement. We suggest

that the City Rideshare Program Administrator accept this responsibility.

The first task of the TIG is to develop a basic telecommuting policy, giving minimum standards and implementation guidelines for the entire City. The duty of each member of the TIG, beyond contributing to the overall standards and guidelines, is to coordinate any expansion of those for her/his own department. The policy should include personnel selection and training criteria and methods; satellite office requirements and implementation procedures; work rules; technology needs; and evaluation requirements and procedures, as a minimum.

Because motivation of managers is fundamental to the success of telecommuting, it is vital that the members of the TIG be movers and shakers, rather than passive coordinators. Their fundamental role, once standards and guidelines are developed, may be to change attitudes within their own departments, where existing attitudes are impeding acceptance of telecommuting. This requires that they be selected on the basis of their leadership and influence with their colleagues.

Further, it is important that the members of the TIG have a minimum tenure of two to three years and that they are suitably rewarded or recognized for their efforts. That is, they should not view their responsibilities to the TIG as just another unwelcome burden.

Telecommuting Expansion Project

In a sense, the Telecommuting Expansion Project is a larger scale version of the Pilot Project. The process is quite similar. First, the Mayor and Council should address the issues of the necessary infrastructure: telecommunications and computers. As we have found from the Pilot Project, a fairly substantial amount of telecommuting can occur with little or modest impact on the budget. However, a fairly small increase in availability of personal computer hardware and software; and an expansion in mainframe access can have substantial additional effects. These issues should be clearly identified, if not resolved, before the next step.

Second, a new series of briefings and/or informal meetings with department General Managers and senior managers should be made, either as a group or on an individual basis. Those briefings should focus on the key policy issues and, where there are Pilot Project data, on the specific experiences in their own departments. No department should be left out of this process. Each General Manager should be asked to develop a telecommuting implementation plan and schedule. The plan should include technology needs.

Third, a series of briefings to mid-level managers and supervisors should be held, on a department by department basis. The purpose of the briefings is to acquaint them with the results of the Telecommuting Pilot Project. Wherever possible, telecommuters and telemanagers from their own departments should attend the briefings and voice their own views on the benefits and risks of telecommuting. The desired outcome of these briefings is that the managers will develop implementation plans for their own groups.

During the first stages of the implementation, some managers — and some departments may continue to reject telecommuting as an option for them. Our strategy has always been, and continues to be, to insist that participation be voluntary at all levels of management. However, in the case of departments that have refused telecommuting and have not achieved the necessary AVR levels by other means, the General Manager should be required to show clearly how the department can achieve its AVR goals without using telecommuting.

Fourth, all potential telecommuters should be given briefings on telecommuting, including clear descriptions of the work options and responsibilities of telecommuters, and should be given an opportunity to volunteer to become telecommuters.

Fifth, it is our opinion that the volunteers and their supervisors should go through some formal selection process that serves as a means for identifying possible problems with telecommuting. If nothing else, the process tends to focus attention on a key ingredient of telecommuting: trust and quality communication between supervisor and employee. During the Telecommuting Pilot Project a set of formal background questionnaires[33] was used for this purpose.

Sixth, the selected telecommuters and telemanagers should be given formal training in telecommuting management techniques. Ideally, the extent of training required by members of a particular work group depends on the level of independence already achieved within the group. In some cases, very little additional training is required. In other cases, several hours of training may be in order. Our experience during the pilot project was that two hours of training for the telecommuters and two hours for the telemanagers was the minimum acceptable for most of the

[33]The questionnaires were administered to both the prospective telecommuters and their supervisors. This background evaluation was limited to the Pilot Project but will be available to the City for further implementation at a nominal cost per telecommuter.

groups. Some groups needed more detailed training, as we determined from subsequent focus group sessions.

Steps three through six need not be completed for all of the telecommuters at once. A better strategy for large departments may be to implement telecommuting on a division by division basis, or even in smaller increments, as dictated by operational considerations. The overall schedule may be dictated by the requirements of the SCAQMD.

TeleService Pilot Project

Although the focus of this project was on reducing the level of commuting by City employees, another major opportunity was suggested repeatedly during the course of the project: Why not use telecommuting as a means of more effective local delivery of City services?

The rationale is as follows. The City has an extensive array of service-providing facilities distributed throughout its area. But many of these are single function facilities, such as fire and police stations, parks buildings, and the like. Although there are multi-function facilities in locations other than downtown Los Angeles, such as the Van Nuys, West Los Angeles and San Pedro City Halls, they are few and far between. Further, there are no such facilities to serve areas of particularly high need, such as South-central or East Los Angeles.

Because not all services are available throughout the City, citizens of Los Angeles spend significant amounts of time and effort traveling from their homes and businesses to City facilities in order to receive any one of the variety of services provided by the City. Often, they are required to visit several different locations before receiving all of the services they need. Presumably, some citizens give up the search in frustration before getting the services. There are no quantitative data available as to the magnitude, extent and success of this taxpayer travel activity.

Given the severe constraints on the City's budget, it is not likely that a series of conventional local City Halls will be built any time soon. However, it seems entirely feasible to do "reverse telecommuting:" to use existing City facilities that are turned into multi-purpose operations for disseminating a variety of information and completing routine City-citizen transactions. Applicants would be able to go to a local City facility and be in contact with the required experts regardless of the actual location of the experts.

This need not result in major inroads on facilities that are already overcrowded. For example, a variant of the information kiosks that are being tested by the State of California might provide significant increases in localization of services. Increased telecommuting by the

usual occupants of existing facilities might free up enough space so that the conversion of some of it to multiple uses would be essentially invisible.

The technology required to accomplish this is already in existence. No new inventions are required. Two key questions are: what level (read cost) of technology is required to deliver what services?; and how important are the benefits derived from the localized delivery? As an example, the Department of Telecommunications is investigating the requirements for a broad-band network interconnecting City facilities. The existence of such a network would be a major asset for implementing a broad TeleService program.

As is the case with telecommuting, the benefits derived from a TeleService program may significantly exceed operating costs. However, until a more thorough analysis is made of the opportunities, issues, potential benefits and costs, it is not possible to gauge the total impact. Therefore, we propose that a pilot TeleService project be planned and developed to explore the opportunity.

Interagency Facilities Sharing Project

Sponsored by the Institute for Local Self Government,[34] a project is currently under way to develop and demonstrate office space sharing arrangements among local governments. The central concept of the project is that local governments can develop satellite office telecommuting arrangements without necessarily leasing new office space elsewhere. A City of Los Angeles employee living in, say, Rialto could telecommute part time from the Rialto Civic Center rather than commuting to downtown Los Angeles — and vice versa.

The primary barrier to demonstration of satellite center telecommuting during the City project was the rule that the City would lease facilities only for a minimum duration of several years. While this is a quite reasonable approach for negotiating the most favorable leasing terms, it was not possible to lease space for only a few months (the duration of the project) in areas close to City employee residences.

Early in the project we identified more than seven areas where satellite offices could effectively serve City employees. None of them included an existing City facility. Most were outside the City limits. Only near the end of the data-taking stage of the project were we able to reach an agreement with the Ontario Telebusiness Work Center to house one telecommuter outside the City limits.

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[34]The ILSG is a non-profit, non-partisan reserach and education organization affiliated with the League of California Cities. Its mission is to promote and strengthen local self government.

To test the impact of a network of available telework centers, we used our computer program for evaluating the AVR impacts of various travel demand management strategies. Our analysis of the residence and work locations of a sample of 580 prospective City telecommuters indicates that only 4 now work at the City (or other public agency) facility nearest their homes. The other 576 would save more vehicle miles by either telecommuting at home or from a different faciltiy than their principal office. For the whole group of 580 employees, including some current home-based telecommuters and some rideshare members, the annual additional vehicle miles saved by telecommuting from a satellite office one day per week would be 900,000 miles (17,600 trips).

Participation in the ILSG project or a similar arrangement could materially expand the City's telecommuting without increasing expenditures for office space.

Appendix 1: Telecommuting Guidelines

The Issues

The general issues of telecommuting are common to most organizations: who controls whom/what; who is liable for what; who pays for what; and who, if anyone, is at a disadvantage as a result of telecommuting? The dominant fear expressed by managers during the preliminary phases of the project was that telecommuting would be forced upon them upon conclusion of the project and that they would have no control over who telecommutes or over how often and under what circumstances telecommuting would occur. An opposite management view was also heard, although it didn't surface until later in the project: "this is just a fad and will go away — we don't have to pay attention to it."

The views expressed by various employee representation groups, both within the City and elsewhere around the world, tend toward: "This is a new way for management to exploit the employees." Here too, another voice is heard: "How can we make it a mandatory option for all employees?"

During the development of the project plan and periodically throughout the project, the usual liability questions arose, typified by: "Who's liable if a telecommuter breaks her leg at home while ostensibly working at two in the morning?" And: "What happens if the equipment used by the telecommuter breaks?" Data security issues also arose frequently, particularly with respect to the possibilities for unauthorized access to the City's mainframe computers.

Finally, the telecommuters' main concerns were the (in their view) possibly frivolous attempts by "management" to

arbitrarily limit — or force — their telecommuting. This apprehension was supported by the failure of several departments to allow many of their trained telecommuters to telecommute, and by others to put strict limits on telecommuting days or schedules. We uncovered no occasions, once the active phase of the project began, where telecommuters felt they were forced to telecommute against their wishes.

Approaches

All of these issues arise from a fundamental adversary attitude, possibly supported by past experience, on the part of all of these groups of people. Lurking in this background is the leaden rule: *Do unto others as you think they will do unto you — only do it to them first*.

The dilemma arises from the fact that successful telecommuting requires an attitude of trust and cooperation among the participants. The question is, can a set of rules be developed that acts to encourage growth of the necessary trust, while avoiding the trap of relying on blind faith?

We should emphasize that these concerns were by no means universal. There was abundant evidence during the project that many telecommuters and their supervisors had well developed and proven feelings of mutual trust. Nevertheless, in those cases where such trust is nonexistent or uneasy, it is important to establish some fundamental rules that will act to help improve the situation.

Consequently, the following recommendations are designed to stipulate the roles and responsibilities of telecommuters and telemanagers is such a way as to promote increasing feelings of trust without being unduly restrictive upon the prerogatives of either telemanagers or telecommuters.

A Core Set of Work Rules

The following rules are proposed as a general guide for City Departments in establishing clear relationships between telecommuters and Department management. Some of these rules should be inviolate, while others may be subject to negotiation. Consequently, we have separated them into two groups.

Absolute Rules

- **Telecommuting is a management option, not an employee entitlement**. Successful telecommuting requires that both the nature of the work to be performed and the working relationships between the telecommuter, the telecommuter's colleagues and her/his supervisor be consistent with the principles of location independence for the period of telecommuting.

- **Telecommuting must always be voluntary** for both telecommuter and his/her supervisor(s). Either the telecommuter or his/her supervisor may elect to discontinue the telecommuting if: a) the telecommuter is not comfortable with telecommuting; or b) the telecommuter is not performing to mutually pre-agreed upon work standards. Any discontinuation of telecommuting must occur upon adequate prior notice.
- **Telecommuters and their direct supervisors must be given training** in the management aspects of telecommuting prior to beginning telecommuting if they do not already operate in a location independent mode.
- **Performance evaluation of telecommuters should be based on prior mutual agreement**, between the telecommuter and his/her direct supervisor, as to specific work goals, objectives and schedules. Although specific objectives and schedules may be based upon estimated times to complete tasks, performance evaluation should not be based on time-to-complete.
- **Telecommuters are regular employees**, not subcontractors.
- **There is no distinction in rates of pay and benefits** between telecommuters and non-telecommuters.
- **Telecommuters should be given the same opportunities as non-telecommuters for promotion and career development,** including access to additional training.
- **Telecommuters should have regular opportunities to meet** their telecommuting and non-telecommuting colleagues in their organizations in order to minimize any feelings of isolation or exclusion.
- **Telecommuters should have access** to electronic mail, voice mail and/or whatever other means are normally used in an organization for keeping them linked with their colleagues.
- **Telecommuters and telemanagers should establish a regular schedule** or other method for maintaining suitable levels of communication with each other.
- **There should be no arbitrary limitation on telecommuting schedules and frequencies**. The specific schedule and frequency of telecommuting for

an individual telecommuter should be dictated solely by the needs of the work unit and the availability of sufficient quantities of "telecommutable" work, not by any unfounded expressions of distrust of the telecommuter such as prohibiting telecommuting days adjacent to "off" days.

- **Telecommuters should have the same rights and access to representation** as their colleagues.

Negotiable Rules

- **Telecommuters should not be required to perform in excess of their in-office levels** as a condition of beginning/continuing telecommuting. An alternative, less protective version: **Telecommuters should not be required to perform in excess of their in-office levels** as a condition of beginning/continuing telecommuting **to the extent that they feel stressed from the extra load**. Telecommuters naturally tend to perform more effectively and feel less stress during their telecommuting days but the fundamental success criterion for the project was to reduce automobile use while maintaining normal levels of performance.
- **All operating costs of telecommuting**, such as business related telephone charges, office supplies and special software or necessary software upgrades, shall be paid for directly or reimbursed to the telecommuter by the City.
- **All necessary equipment and equipment maintenance costs should be covered by the City** in all cases where the telecommuter needs the equipment for telecommuting but does not own, is not able to, or desires not to use her/his own equipment. Several prospective telecommuters were eliminated from participation in the project because they did not have suitable computer equipment at home. Our surveys indicate that the benefits from performance increases to be expected from telecommuters far outweigh the costs of additional computer equipment.
- **Telecommuters may use their personal computer equipment and/or software for telecommuting**, provided that it is compatible with City computers. Many of the City's telecommuters have personal computer installations that are superior to that available in their principal offices. However, in these case the employee, not the City, should be responsible for the maintenance of the

equipment and/or software. The employee should also be responsible for insuring that any of her/his software used for City related work is virus-free and compatible with City software.

- **The City retains the right to, and telecommuters have the right to insist upon, inspection** of home offices and computer equipment/software for safety, adequacy and security.
- **The schedule worked by a telecommuter need not be that same as that of the principal office**, provided that the schedule is given prior approval by the telecommuter's supervisor. For example, given prior approval, the telecommuter may begin and finish work earlier (or later, or some combination other) than the normal office schedule.
- **Telecommuters must be reasonably accessible, via telecommunications, to the principal office during normal work hours**, or during some portion of normal hours, given prior approval by the telecommuter's supervisor. In the latter case, the hours of accessibility and work need not be entirely identical. "Reasonably accessible" means that the telecommuter should respond to a call from the office within some time limit mutually agreed upon by the telecommuter and his/her supervisor

Most of these rules were covered in the manuals issued to the telecommuters and telemanagers as part of the training process. They have been amended and augmented as a result of the experience gained during the project.

Legal Approaches

As with the general management and labor relations issues addressed above, the legal aspects of telecommuting are not materially different from those of the traditional workplace. These issues focus primarily on responsibility and liability. The following proposed rules[35] address those issues.

- **A telecommuter is covered by Workers Compensation Insurance regardless of the location of her/his workplace and work hours,** provided that the work location and schedule was given prior approval by the telecommuter's supervisor.
- **Accidents at a telecommuter's home to persons who are not employees of the City of Los**

[35]Note that JALA International, Inc. is not a law firm. The recommendations given here deal with the substance of the issues and may or may not be in appropriate legal format.

Angeles or, if they are employees, are not engaged in City work activities, **are the responsibility of the telecommuter**.

- **Telecommuters are responsible for protecting City information in their possession, or accessible through the use of equipment in their possession,** regardless of their work location. Any sensitive information in a telecommuter's possession must be given at least the same or equivalent physical protection as would be used or available in the telecommuter's principal office.
- **Telecommuters are not to use City provided equipment or software to perform work for any other employer**.
- **Telecommuting shall not be required as a condition of employment**.
- **The City is not responsible for that portion of home utilities costs or space rental that is attributable to a telecommuter's telecommuting activities**. During the training sessions we stressed that it was extremely unlikely that City employees could deduct the costs of home offices in their federal income tax forms unless telecommuting was required as a condition of employment. A recent Supreme Court decision has strengthened that rule. There are current moves in Congress to change the tax laws so that telecommuters can receive some tax benefits. However, unless and until that occurs, home telecommuters can not deduct those expenses.

Appendix 2: Evaluation Methodology

Two types of evaluation, summative and normative, were used to assess the efficacy of telecommuting. The summative (or 'what has been happening?') evaluation was made via a series of questionnaires administered to the telecommuters, and, in some cases, their families; their supervisors; and members of the control group. A cost-benefit model was derived from the summative evaluation data and from other departmental statistics. The normative evaluation (or 'where should we be going?') evaluation was achieved via individual interviews and a series of focus group meetings.

The control group was composed of City employees who otherwise would have been qualified to be telecommuters but who elected not to telecommute during the course of the project. That is, the control group members were selected to be as similar to the telecommuters as possible, given the variety of personalities and job types in the project.

Summative Evaluations

The summative evaluations comprised two different types of evaluation: overall impact assessments, including a cost-benefit model; and a travel demand analysis. The impact assessments were made via three series of detailed questionnaires[36] that covered general demography; the adequacy of the City's information infrastructure; personnel roles and information activities; technology use;

[36]These questionnaires have been used by JALA in a variety of telecommuting projects, in both the public and private sectors, since the mid-1980s.

commuting patterns; telecommuting details; implementation issues; and overall performance impacts. These lengthy questionnaires, often requiring two hours to complete, were administered to the telecommuters and control group members at the beginning, mid-point and conclusion of the data-taking phase of the project. Supervisors of telecommuters and control group members were also given short evaluation questionnaires, focusing on performance issues. These were administered at the same times as the telecommuter/control questionnaires.

Although the general evaluation questionnaires provided overall information on the trip reduction impacts of telecommuting, it was important to get some information on a persistent question about telecommuting impacts: does telecommuting simply act to move the distribution of trips around, with no overall effect on travel? That is, while telecommuters may not use their cars on telecommuting days, they may use them more than usual on non-telecommuting days, including weekends. Therefore, the telecommuters and members of the control group — as well as their driving age family members — were asked to complete logs for each trip made, for whatever purpose, over a period of one week in March, 1992.

The data derived from all of these formal questionnaire series were used to complete a cost-benefit model that quantifies the known dollar impacts of telecommuting and provides a means of forecasting future impacts under various telecommuting scenarios. A related model was developed that provides a comparative analysis of telecommuting with other means of trip reduction, such as carpools and vanpools.

Productivity vs. Effectiveness Measurement Issues

One of the key economic impact statements about telecommuting is its effect on productivity. There are some very important distinctions to be considered here since major economic commitments may be made on the basis of productivity estimates. The following describes my considerations in developing the various evaluation questionnaires.

Strength of Inference

The results of the surveys, occurring as they did in the real world instead of a laboratory, are complicated by the time-varying composition of the group of telecommuters. Transfers, departures, switches to and from telecommuter/control status (some individuals did this more than once) all tend to obfuscate the results. Consequently, where important factors in the evaluation are discussed, we have included confidence estimates of the reliability of the conclusions. These are generally in the form of an estimate of Type I error: the likelihood that two sample populations (such as telecommuters and controls) are really identical even though the statistic says they

aren't. This is expressed in the form of a probability, p, that the two populations are the same. The lower this probability is, the more likely it is that the populations are indeed different. Ordinarily we don't state that two groups are different in the characteristic in question unless the p-value is 0.1 or less, preferably less than 0.05. That is, the odds are 9 to 1 or 19 to 1 or more [(1-p)/p], respectively against the two groups being the same.

Productivity

Productivity is a loaded term. In particular, manufacturing productivity is usually taken as the model. One has mental images of whiz-bangs being turned out like clockwork. Productivity in this situation is measured as the ratio of the price received for the whiz-bangs produced, divided by the cost of production. When one turns to information work the first problem is: what's the product? In the case of clerk typists the identifiable product may be typo-free letters and memos going into the mail. In the case of a detective or a policy analyst, as examples of the types of telecommuters in the project, the measure of productivity is significantly less well defined. In any case, productivity is a measure of doing things right.

Effectiveness

Effectiveness is the term we prefer to use. Our approach is that productivity is the wrong term to use in any case. This is specifically because of the tendency to count things (letters, typed, decisions made, briefs or specifications written, etc.) as the means of measure. This distracts one from the real purpose of information work: to generate or convey information and to affect decisions. This is a broader concept and, unfortunately, one that is even harder to measure. But the breadth is, we feel, in the right direction. Effectiveness is a measure of doing the right things - and doing them right. As such, it includes productivity as a component, but someone who is very efficient/productive at doing the wrong things is decidedly not effective.

Measuring changes rather than absolutes

It is not possible to measure absolute levels of information work effectiveness, if for no other reason than that there is no consensus on what it is. However, most individual information workers, and their supervisors, have a feel for what has changed over some relatively short period, such as a few months to a year or two.[37] In this way we do not

[37]Even periods of one or two years' duration can be difficult to measure since one's memory of what one did as long as a few days ago can often be faulty.

have to be concerned with what the elements are of the effectiveness evaluation; we do not sink into the pit of endless qualifications of measures for each type of job. We simply ask what has changed, and proportionately how much, in whatever terms the subject is used to thinking of his/her own (or his/her own subordinate's) effectiveness.

Intergroup comparisons

In addition to focusing on changes rather than absolutes, we compare estimates of effectiveness. We compare the self estimates of the telecommuters with the self-estimates of the members of the control group. We compare both of these with the estimates made by the telecommuters'/controls' supervisors of their effectiveness changes. We compare the final self-estimates with the pre-telecommuting self-estimates.

Related measures

Finally, we also examine what has stayed the same. What hasn't changed? The work environment, the roles played by the individuals in their work, the work activities in which they engage, the technological tools they use, the factors that make up effectiveness measures are all part of our evaluation questionnaires. That is, we try to detect any changes in the work environment that might explain changes otherwise attributable to telecommuting. If these work-environmental factors are unchanged and/or common to both the telecommuter and control groups then any effectiveness differences between the groups are more likely to be attributable to telecommuting. Note that there were no significant differences detected in these factors in the pre-telecommuting, the first annual and the final evaluations. In the interests of reducing the length of the questionnaires (and reducing the strain on the respondents), the information infrastructure and work roles questions were dropped from the first annual questionnaire.

Normative Evaluations

Although the summative evaluation techniques provide quantitative snapshots of the impacts of telecommuting, it is also important to be able to improve the process in mid-course. To that end, two series of focus group sessions were held, at about the one-third and two-thirds points in the project. These were augmented by informal meetings and telephone conversations with telecommuters throughout the project, often in response to queries about procedural issues.

The focus group meetings were relatively informal but were structured to elicit comments and suggestions about problems with technology, operating procedures, working

relationships, personal and family impacts of telecommuting. The meetings also served as a means of reinforcing some of the management approaches covered in the initial training sessions. During the first series of meetings the telecommuters and their supervisors met separately, in case there was any reticence about discussing management problems with supervisors (or telecommuters) in attendance. In the second series of meetings, the telecommuters and supervisors met together. There was no substantive difference in the outcomes between the two sets.

Appendix 3: Quotes from Supervisors

The following is a set of comments from the supervisors who completed evaluation forms in the final round of surveys. *[Italicized comments in brackets, for the following items, are those of the author.]*

Good News

- Even with an increased caseload, and the increased complexity of cases, [the telecommuter] has maintained his level of effectiveness. I believe this has been possible because of the quality time telecommuting affords him.
- Telecommuting has allowed [the telecommuter] to keep pace with an increased workload, more complex cases, and specific projects.
- We accomplished things with telecommuting that we haven't been able to do for four or five years. Telecommuting gaves us the time [and the freedom from interruptions] that let these tasks be finished with outstanding results.
- This employee has a significant impairment (physical) to her performance. The telecommute day has helped compensate so that she is more productive, even though her overall performance is below her prior capability. (She has a degenerative disease that is also impairing her mental processing.) Telecommuting is a job saver for her and us.

- I'm very supportive of telecommuting. Originally my support was theoretical. Today it is based upon actual practice. The "quiet" or undisturbed time available to telecommuters allows for very productive work on certain tasks/assignments.
- Our work is difficult to quantify in terms of how long a particular part of it should take, and as everyone is at a different task at different times, it just is not clear if someone is getting more, less or no change in the work done. The only thing I can tell is that telecommuters are happy about telecommuting.
- Telecommuting has helped [the telecommuter] as well as other employees I am familiar with in increasing productivity in that they can work on a project with no distractions such as phone calls and people dropping by to talk.
- Telecommuting has forced [the telecommuter] to be a more organized worker. He has had to plan his work here and at home. He stated that the flexibility in work environment and work schedule has helped relieve the boredom that comes with doing repetitive tasks.
- This individual has been on medical leave of absence. We attempted to use telecommuting to alleviate the degree of worksite pressures. While she telecommuted, her production record improved.
- We are suffering a 50% staffing shortage at this time and are convinced that telecommuting has helped us to maintain an acceptable level of case processing.
- I think the telecommuting program should be continued since the productivity, volume of work, increased for the engineers I supervised.
- Due to required meetings, field work, employee unable to complete telecommute goal of once every two weeks. Excellent use of time the few times she did telecommute. Employee is very productive at the office and in the field and at home telecommuting.
- For certain tasks/functions/projects and employees telecommuting is, in my opinion, vastly more effective than traditional methods. I would like to see it gain acceptance.
- I am also convinced that **many** employees under my supervision could be more productive if they

"telecommuted" (and did not have to contend with phone and other interruptions).

- Telecommuting works very well with this motivated employee. When large complex projects need to be completed in a short period of time, she works from home without interruption. She makes optimum use of the phone for communication and for providing and receiving information. She uses her own computer equipment.
- [The telecommuter] lives near [a City facility]; on several occasions, he was able to do field work "next door" without having to travel downtown and back. For him, [the facility] became a ready-made "satellite center."
- Employee lives 29 miles from work. Effective use of employee's time. Special responsibilities of the job lends itself to telecommuting.
- There is no doubt in my mind that all of our professional and most of our clerical staff could significantly benefit by telecommuting once or twice per pay period. Too many distractions in the office (much public comment telephone work).
- [The telecommuter's] job performance is higher than the average engineer and that continued with telecommuting. He has outstanding PC skills which makes his telecommuting more effective and he has flexible approach to when telecommuting is done. He is well organized and plans ahead which also adds to his being very effective in a telecommuting program.
- I have found that telecommuting works well when an employee is assigned a project that requires extensive reading and analysis.

Mixed News

- [The telecommuter] initially focused on reports and manuals. Later she had access to a main frame connection and devoted time to testing and trouble shooting new information systems. I had to limit the main frame access when I was pressured to keep the phone bill under $70.00 per month. For an effective program, the Dept. needs to solve the Telecommunications Cost Problem by placing low cost or toll free nodes near the telecommuting employees.
- There has been a slight increase in my workload duties that [the telecommuter] would have

handled had he been present, but at the same time this was offset by the greater productivity.

- I believe that telecommuting is a very good program. But the effectiveness of the program is very much dependant upon "the employee" who participated in the program. Most of the participants are performing well but some would be kind of abusing the system (program*). [Hence, the need for pre-telecommuting screening.]*
- The work was tailored to be effectively done at home. Because main frame accessibility was not available to [the telecommuter] , her work focused on reports, manuals and studies. She was able to accomplish almost two days work in one telecommuting day at home. This was a Win-Win for the Dept.

Not So Good News

- Employee lives one mile from work. More effective on job site as position already requires off site field work. *[This and the following quote are from the same supervisor.]*
- Employee lives two miles from work. Responsibilities of position more effectively carried out at work site since job has extensive field work outside of the office. *[Meeting requirements, in a period of great transition, made more telecommuting difficult for these two. Teleconferencing systems might have lessened the problem.]*
- The city has chosen to operate its pilot program on the basis of telecommuters taking one day off per week. I'd like to see a more irregular schedule. *[Note: See the comment on the next quote.]*
- We have removed all our telecommuters from weekly, fixed telecommuting days and have made the option available to any staff member, on a periodic basis, provided that there is justification. We found the practice of having fixed telecommuting days to be negative in that staff began to assume the day as an employment right rather than a privilege. *[Note: Considerable time was spent during the training sessions and in subsequent focus group sessions about the relative advantages and disadvantages of fixed/variable telecommuting schedules, stressing the likely need for flexibility. One can lead a horse to water . . . .]*

- Due to personal problems and work related changes in duties and assignments the telecommuting option did not work out for [the telecommuter]. We both continue to be positive in attitude towards it and if situations change would re-implement. *[Satellite office telecommuting might work out better for this telecommuter.]*
- On the plus side [the telecommuter] is very productive on his TC day. On the down side [the telecommuter's] work (we feel) must be reviewed. *[Note: A major part of the training deals with the work definition and review process. It is interesting to note that the requirement to review output apparently is considered by this supervisor to be a novelty, not applicable to in-office workers.]*

Bad News

- Due to the assignments and upgrading of our work environment [the telecommuter] has not telecommuted in the past several months. There has been a significant decrease in productivity on two of her existing assignments. ***Also, because our [senior] manager is unwilling to commit his team to the program, it is no longer one of his top priorities to promote this program. He finds it easier not to support even if the participants are already enrolled in the program.*** *[Emphasis added.]*
- [The telecommuter] elected to stop telecommuting because of too many interruptions at home. *[Note: We find this happens with less than 5% of home-based telecommuters.]*
- This program required more structure, training and monitoring to be effective. Passing out this questionnaire 5 mos. after we terminated the pilot project is ludicrous. *[Comment by a supervisor who was trained but neither supervised a telecommuter nor attended subsequent focus group sessions. Only two of the active departments, accounting for 9 telecommuters, formally terminated their telecommuting as of July 1992.]*