

Employee Attitudes and Stated Preferences Toward Telecommuting: An Exploratory Analysis

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The potential effectiveness of telecommuting as a demand management strategy depends on the extent to which it is adopted by firms and accepted by employees. To gain insight into the factors likely to influence the adoption process, a survey of employees was conducted in three Texas cities: Austin, Dallas, and Houston. In this paper the survey results, focusing on the attitudes toward telecommuting held by employees who presently do not telecommute as well as on their stated preferences toward different telecommuting options are analyzed. Individual and job-related characteristics likely to influence employee participation in telecommuting programs are identified. The results suggest that successful programs are likely to require some job redesign and means of fair performance evaluation. In addition, success appears to depend on the economic arrangements involved, as most employees seem reluctant to trade income for the flexibility afforded by working from home.

The concept of the electronic homemaker was proposed in 1957 automation literature. It was not until the 1970s, however, that this idea first received public attention, motivated primarily by the energy crisis (1). The term "telecommuting" was initially coined by Nilles and defined as "the partial or total substitution of telecommunications for the daily work trip" (2,3). Telecommuters were first considered as full-time homeworkers. It is now recognized that telecommuting need not to be full time and that working from home is not the only possible type of telecommuting (4). For instance, Nilles defines four types of telecommuting: home based, satellite centers, local centers, and neighborhood centers (3).

Telecommuting received its second round of public attention in the 1980s. With increasing concern over urban traffic congestion and air quality, telecommuting has been proposed as one element of a broader array of measures aimed at reducing work trips and engine emissions in peak hours. In addition, it is advocated as an opportunity for parents with young children or workers with disabilities to participate more fully in the labor force (5,6). Furthermore, some managers believe that a properly designed telecommuting program may enhance their company's image as providing a good work environment, thereby improving their ability to recruit qualified employees (7). Other advantages of telecommuting are also mentioned in the literature (7-9). For participating employees, the major advantages include (a) less travel time and cost, (b) fewer distractions during work hours, (c) more sched-

uling flexibility to meet family commitments, and (d) greater opportunity to participate in community activities. For the companies, the major purported advantages include (a) lower overhead costs for offices, (b) less turnover, (c) higher employee productivity, and (d) better morale of employees who are telecommuters.

Several possible disadvantages are also identified (7-9). For employees, these include (a) less opportunity for social interaction with coworkers, (b) fewer opportunities for on-the-job learning from senior workers, (c) possibly lower salary under some scenarios, and (d) fewer opportunities for promotion. For companies, the major possible disadvantages include (a) potentially high initial investment, (b) difficulty of performance measurement, (c) resistance from management, (d) resistance from unions, and (e) less data security. Also, some researchers have indicated that telecommuting should be viewed not only as a transportation or management issue, but also as a psychological and sociological issue because it affects the life styles of both the employees and members of their households (9,10).

An essential element in determining the potential impacts of telecommuting is the extent to which it is adopted by firms and their employees. Limited information is available on the adoption process by employees and employers, and most of it is anecdotal or speculative in nature. The objective of the present study is to investigate this process. For this purpose, a survey of firms has been conducted in three Texas cities: Austin, Houston, and Dallas.

According to Fishbein and Ajzen's (11) general attitude-behavior model, behavior is affected by intentions that are in turn influenced by attitudes. Within this framework, Samuelson and Biek (12) found that individuals' actual energy conservation behavior is related to their attitudes toward energy use. In the absence of a large base of established telecommuters, prevailing attitudes toward telecommuting can provide useful insights into the factors that affect a person's likelihood to adopt telecommuting.

This study focuses on employees' attitudes and stated preferences toward home-based telecommuting, also referred to as "work from home." It presents an exploratory analysis of the data obtained from the telecommuting survey conducted in Austin, Houston, and Dallas, Texas. After describing the survey, the general characteristics of the respondents are summarized. Then, the responses to the attitudinal questions are analyzed, including a confirmatory factor analysis to validate

the logic underlying the design of these questions, followed by highlights of the substantive attitudinal information obtained in the survey. Employees' stated preferences toward alternative telecommuting scenarios are then discussed, followed by concluding comments.

SURVEY METHOD

The data used in this study are from a survey of employees in selected organizations in three Texas cities: Austin, Houston, and Dallas. The questionnaire is composed of four sections. The first section asks the respondent to identify commuting trip information and job characteristics. Commuting trip information includes travel distances and daily travel times. Job characteristics include the respondent's job title; the amount of time the respondent spends communicating with customers, supervisors, subordinates, or coworkers; and what form of communication he or she uses. The second section addresses the respondent's attitudes toward telecommuting, measured by Likert's five-score, bipolar scales (11). The third section asks the respondent to identify his or her stated preferences for alternative telecommuting scenarios. These scenarios are defined in terms of different combinations of out-of-pocket costs assumed by the employee to work from home (ranging from all costs borne by the employer to all costs borne by the employee) and corresponding salary changes. The last section

addresses the respondent's socioeconomic characteristics, such as gender, age, household income, and computer proficiency level.

Questionnaires were sent to selected organizations and distributed to their employees through personnel officers. These organizations were selected on the basis of four criteria: (a) potential for telecommuting; (b) firm size, measured by number of employees or total billings; (c) geographical location, such as a central business district or suburb; and (d) business activity, such as computer software, engineering consultancy, or accounting. Seventy-two organizations were chosen and 3,814 questionnaires were sent for distribution to employees, of which 694 usable questionnaires were received. Table 1 lists the sample distribution across the business activity of the firms by city.

GENERAL CHARACTERISTICS OF RESPONDENTS

Individual, Household, and Commuting Characteristics

Table 2 summarizes the sociodemographic and commuting characteristics of the survey respondents. A majority (56 percent) are female; 75 percent are between 18 and 40 years of age. Most of the respondents (91 percent) have attained a

TABLE 1 Number of Questionnaires Sent and Received (by Business Sector and City)

Primary Activity	# of organizations selected				# of questionnaires delivered				# of questionnaires received			
	A	D	H	T*	A	D	H	T	A	D	H	T
Accounting	1	2	1	4	25	150	100	275	7	42	0	49
Advertising	1	1	2	4	30	100	107	237	17	0	29	46
Architecture	1	1	1	3	15	50	100	165	7	31	12	50
Banking	0	0	1	1	0	0	100	100	0	0	0	0
Computer/software	4	3	3	10	275	235	59	569	109	11	7	127
Engineering	1	2	1	4	75	100	50	225	23	24	0	47
General consultant	2	0	1	3	32	0	10	42	0	0	2	2
Government	0	1	1	2	0	30	100	130	0	19	40	59
Hospital/medical	2	1	1	4	150	50	40	240	11	0	3	14
Insurance	1	2	2	5	12	110	120	242	4	0	1	5
Law	1	2	2	5	25	115	180	320	2	24	0	26
Manufacturing	1	1	2	4	25	100	125	250	3	0	14	17
Oil	0	3	2	5	0	93	18	111	0	31	10	41
Publishing/translating	2	0	0	2	210	0	0	210	110	0	0	110
R & D	3	0	0	3	255	0	0	255	35	0	0	35
Real estate	1	1	1	3	25	10	50	85	4	0	12	16
Stocks	1	1	1	3	60	50	40	150	18	2	0	20
Telecommunications	1	1	2	4	3	100	55	158	3	0	20	23
Travel	1	1	1	3	30	10	10	50	7	0	0	7
Total	24	23	25	72	1247	1303	1264	3814	360	184	150	694

* A: Austin
D: Dallas
H: Houston
T: Total

TABLE 2 Individual and Household Characteristics

Characteristics	Categories	Relative frequency (%)
Gender	Male	44.3
	Female	55.7
Age	Under 18	0.0
	18-30	35.6
	31-40	39.8
	41-50	17.4
	51-60	5.5
	above 60	1.7
Educational level	Finished high school	4.2
	Some college or university	25.0
	Finished college or university	48.6
	Master	16.3
	Ph.D.	1.4
	Other	4.5
Household income/year	Less than 25,000	12.7
	25,000-50,000	44.0
	50,000-75,000	28.9
	More than 75,000	14.3
Number of telephone lines at home	0	2.0
	1	85.3
	2	11.5
	3	1.0
	4	0.1
With FAX at home	Yes	1.9
	No	98.1
Subscription to electronic home-shopping	Yes	6.5
	No	93.5
Number of personal computers at home	0	53.1
	1	42.4
	2	3.5
	3	1.0
Proficiency level in word processing	high	40.3
	medium	35.3
	low	13.0
	non-existent	11.4
Proficiency level in spreadsheets	high	22.0
	medium	28.0
	low	22.0
	non-existent	28.0
Proficiency level in data processing packages	high	10.0
	medium	20.2
	low	25.4
	non-existent	44.4
Proficiency level in computer programming	high	13.7
	medium	8.2
	low	21.2
	non-existent	56.8
Proficiency level in computer graphics packages	high	14.5
	medium	18.8
	low	24.9
	non-existent	41.9
Distance from home to the workplace (miles)*	mean	14.0
	standard deviation	10.8
AM travel time from home to the workplace (minutes)*	mean	26.5
	standard deviation	15.8
PM travel time from the workplace to home (minutes)*	mean	28.8
	standard deviation	17.0
AM stops on the way from home to the workplace, per week*	mean	2.0
	standard deviation	3.0
PM stops on the way from the workplace to home, per week*	mean	3.8
	standard deviation	3.5

* : Numbers in these items are not relative frequencies.

high education level, with 66 percent having completed college or university and 18 percent having attained a master's or doctorate degree. The household income is approximately normally distributed, with the mode in the range of \$25,000 to \$50,000/year.

Employees were also asked about the number of telephone lines, facsimile equipment, and personal computer availability at home, because such equipment may be of use in telecommuting. Only 13 percent of the respondents have more than one telephone line at home. The penetration of home facsimile machines is still limited, with 98 percent of the respondents not owning such equipment. Personal computers are more prevalent, with 47 percent of respondents having at least one personal computer at home, and 5 percent reporting at least two units. However, only 7 percent use electronic data bases or computer-based teleshopping.

To the extent that workers with good computer skills have been identified as a likely target group for telecommuting, the survey asked about proficiency levels in different computer-related skills. Among the respondents, 76 percent have at least a medium level proficiency in the use of work processing

packages, 50 percent for spreadsheets, 30 percent for data processing packages, 22 percent for computer language programming, and 33 percent for computer graphics packages. Overall, 84 percent of the respondents have at least one computer skill at medium or high level.

Commuting information in Table 2 indicates that the respondents on average encounter longer travel time and make more stops in the afternoon trip than in the morning trip. However, considerable variability in these quantities is present across the respondents.

Job Characteristics

Thirty-four job titles were mentioned by the respondents, varying from president to engineer to clerk. These job titles are grouped into 12 categories, (see Table 3) based on three criteria: power in the organizational strategic decision process, schedule flexibility, and suitability for telecommuting. Categories 1 (president/vice president) and 2 (manager/supervisor) have more power in the decision-making process than others.

TABLE 3 Job Titles and Job Categories

Job category	Job title	Freq. (*)	Perc. (*)	Freq. (**)	Perc. (**)
1. President / vice president	President / vice president	10	1.5	10	1.5
2. Manager / supervisor	Director / administrator	27	3.9	108	15.7
	Senior associate	12	1.7		
	Supervisor / manager	54	7.9		
	Technical manager	15	2.2		
3. Writer / editor	Writer	7	1.0	60	8.7
	Editor	47	6.9		
	Photo research	6	0.9		
4. Accountant / attorney	Accountant / tax consultant	59	8.6	72	10.5
	Attorney	13	1.9		
5. Agent	Broker	3	0.4	15	2.2
	Real estate agent	7	1.0		
	Travel agent	5	0.7		
6. Computer programmer	Computer programmer	57	8.3	57	8.3
7. Data processing	Data processing	10	1.5	14	2.0
	Book keeper	2	0.3		
	Typist	2	0.3		
8. Engineer / researcher	Consultant	12	1.7	122	17.8
	Engineer / Architect	92	13.4		
	R & D scientist	18	2.6		
9. Field worker	Clerk / general labor	25	3.6	39	5.7
	Registered nurse	7	1.0		
	Teamster	1	0.1		
	Plumber / mechanic / carpenter	6	0.9		
10. Receptionist / secretary	Receptionist	3	0.4	49	7.1
	Secretary	46	6.7		
11. Coach / trainer	Coach	1	0.1	8	1.2
	School / community liaison	4	0.6		
	Training specialist	3	0.4		
12. General employee	Administration assistant	37	5.4	132	19.2
	Sales / marketing representative	47	6.9		
	General government employee	1	0.1		
	Customer / support analyst	36	5.2		
	Production coordinator	11	1.6		
Total		686	100.0		

* : for Job title

** : for Job category

Categories 3 (writer/editor), 4 (accountant/attorney), and 5 (agent) are assumed to have more schedule flexibility. Categories 6 (computer programmer), 7 (data processing), and 8 (engineer/researcher) are considered to have the most potential for telecommuting. Categories 9 (field worker) and 10 (receptionist/secretary) probably have the least potential for telecommuting. According to Table 3, general employee (19 percent), engineer/researcher (18 percent), and manager/supervisor (16 percent) are the largest three job categories in the sample.

EMPLOYEE ATTITUDES TOWARD TELECOMMUTING

This section discusses the responses to the questions intended to identify the employees' attitudes toward telecommuting. First, the logic underlying the design of the attitudinal questions is validated by a confirmatory factor analysis of the responses. An exploratory analysis and discussion of the responses is presented next, followed by statistical tests aimed at identifying the principal characteristics of the employees and their jobs that influence their attitudes.

Question Design Logic and Confirmatory Factor Analysis

The 18 attitudinal questions used in this survey (see Table 4) in connection with the response of each question were designed to measure the following seven general attitudes:

- Attitude toward and/or perception of transportation system performance (Questions 1, 2, and 3),
- Importance of working in the office (Questions 7, 8, and 9),
- Importance of social interaction with coworkers (Questions 10 and 11),
- Job suitability for telecommuting (Questions 12 through 15),
- Expectation of the effect of telecommuting on job performance (Questions 16 and 18),
- Expectation of the effect of telecommuting on one's family (Questions 4 and 17), and
- Preference toward working independently (Questions 5 and 6).

A principal component analysis (PCA) and a confirmatory factor analysis (CFA) were performed to confirm whether the variation of the responses to the 18 questions could be explained by the underlying seven attitudes. The measured variables in the factor analysis models correspond to the responses to these questions, respectively, with the exception of Variable 1. The number 6 was subtracted from all responses to Question 1 to keep Variables 1, 2, and 3 consistent. The number of factors is specified to be seven in the PCA model. The rotated factor pattern in Table 5, obtained using the promax rotation procedure to address the correlations among factors (13), supports the above design rationale quite well. The cumulative amounts of variation explained to the factors are 2.3, 4.4, 5.8, 8.4, 10.1, 11.4, and 12.6, respectively, in-

dicating that these seven factors together explain 70 percent of the measured variation ($12.7/18 = 0.7$).

In the confirmatory factor analysis, performed using the SAS CALIS procedure (14), the factor pattern is specified as above, with assumed correlations among factors. The estimates of the loadings of variables, reported in Table 6 along with the corresponding *t*-values, indicate that all are significantly different from zero at the 0.01 level. In addition, 10 variables load on the specified factors with values greater than 0.60, usually considered a high loading, while only 1 variable has a loading less than 0.30, which is considered a low loading. Statistics such as the goodness-of-fit index (GFI = 0.90) and adjusted GFI (0.86) indicate that the model fits the observed data very well. An inspection of the residual correlation matrix also shows that the estimated factor loadings predict the correlation matrix fairly well.

Table 7 shows the estimated correlation coefficients between factors. While all terms are significant at the 0.01 level, most of the coefficients are less than 0.5 or greater than -0.5, indicating that, in general, the correlations among factors are not high. The two highest correlations exist between factors 6 and 7 (0.90) and factors 6 and 5 (0.83). That is, there appear to be strong positive correlations between an employee's expectation of the effects of telecommuting on the family and his or her preference for working independently as well as his or her expectation of the effect of telecommuting on job performance.

Discussion of Responses

The responses to the individual questions are shown in Table 4. With regard to the first attitude pertaining to the transportation system, half of the commuters in the sample do not find commuting to work stressful (Question 1). Thirty-three percent think that the traffic is smooth from home to the workplace, although 41 percent think it is congested. On the other hand, 24 percent of the respondents believe the traffic is smooth on the way back home, although 54 percent believe it is congested, confirming the finding in other studies that commuters experience a longer evening commute than in the morning (15).

With respect to the importance of working in the office, 60 percent of the respondents believe that it is essential to their work to have frequent input from their supervisor or coworkers, while less than 20 percent believe it is not. In response to Question 8, 44 percent believe it is important to attend short-notice meetings during the work hours; 36 percent believe it is unimportant. Seventy percent of the respondents believe it is important to have immediate access to information or references available only at the office; only 14 percent believe it is unimportant.

The responses to the questions that address the importance of social interaction with coworkers indicate that 50 percent of the respondents believe it is important to have social interactions with their coworkers at work (Question 10), but only 13 percent feel it is important outside of work (Question 11).

With regard to the job's suitability for telecommuting, only 21 percent of the respondents believe their jobs are suitable for working from home every day. This number increases to

TABLE 4 Responses to Attitudinal Questions

Questions	Responses (relative frequency, in %)				
	1	2	3	4	5
1. Do you find commuting to work stressful ?	19.7 <i>not at all</i>	27.6	22.4	16.1	14.2 <i>definitely</i>
2. On a typical day, how would you describe the traffic you encounter on your way from home to your workplace ?	14.7 <i>too congested</i>	26.7	26.1	19.7	12.8 <i>very smooth</i>
3. On a typical day, how would you describe the traffic you encounter on your way from your workplace to home ?	25.9 <i>too congested</i>	27.7	22.8	14.7	8.8 <i>very smooth</i>
4. How important is flexibility of your work schedule for accomplishing your household duties ?	16.3 <i>not important</i>	11.8	25.5	23.1	23.4 <i>important</i>
5. Would you like to work independently during more of your work time ?	2.8 <i>dislike</i>	5.2	21.8	24.3	45.9 <i>like</i>
6. How do you feel about learning to use new office equipment for your job ?	1.4 <i>dislike</i>	2.6	8.7	23.0	64.3 <i>like</i>
7. How essential to your work is frequent input from your supervisor or your co-workers ?	5.7 <i>not essential</i>	12.9	21.3	25.8	34.3 <i>essential</i>
8. How important is it for you to attend short-notice meetings during your work hours ?	15.3 <i>not important</i>	21.0	19.8	19.9	24.0 <i>important</i>
9. How important is it for you to have immediate access to information or references which are available only at the office ?	4.5 <i>not important</i>	9.1	16.6	22.1	47.7 <i>important</i>
10. How important to you are social interactions with your co-workers at work ?	11.0 <i>not important</i>	12.9	26.0	27.6	22.5 <i>important</i>
11. How important to you are social interactions with your co-workers outside of work ?	35.6 <i>not important</i>	29.9	21.8	9.2	3.5 <i>important</i>
12. Do you think your job is suitable for working from home every day ?	45.3 <i>not suitable</i>	18.3	15.2	12.7	8.5 <i>very suitable</i>
13. Do you think your job is suitable for working from home several days per week ?	31.9 <i>not suitable</i>	15.0	14.9	17.2	21.1 <i>very suitable</i>
14. Do you think your supervisor would approve your working from home every day ?	71.6 <i>not at all</i>	16.5	8.3	2.8	0.9 <i>definitely</i>
15. Do you think your supervisor would approve your working from home several days per week ?	51.5 <i>not at all</i>	21.1	18.2	6.1	3.0 <i>definitely</i>
16. If you could work from home, do you think you could get more work done ?	24.5 <i>not at all</i>	15.1	26.0	15.5	18.9 <i>definitely</i>
17. If you could work from home, how do you think this would affect your relationship with other household members ?	5.9 <i>adversely</i>	9.0	42.1	18.8	24.2 <i>beneficially</i>
18. If you could work from home, what effect do you think this would have on your chance for promotion ?	39.4 <i>decrease</i>	25.7	31.2	1.8	1.9 <i>increase</i>

38 percent when working from home is limited to several days per week. Interestingly, employees believe their assessment of this matter is not likely to be shared by their supervisor: only 4 percent of the respondents believe their supervisors would approve of their working from home everyday. This percentage increases to 9 percent when working from home takes place only several days per week. Clearly, employees overwhelmingly perceive their supervisors as not likely to approve of their working from home. Furthermore, working from home several days per week is more acceptable than everyday.

For the effects of telecommuting on job performance, 34 percent of the respondents believe they could get more work done if they work from home, whereas 40 percent believe they could not (Question 16). The response to Question 18 indicates that 65 percent of the respondents believe working from home will decrease their chances for promotion; only 4 percent believe it would increase their chances. This is an important element that needs to be carefully addressed in efforts and programs to encourage telecommuting. Not surprisingly, 47 percent of the respondents believe the flexibility of one's work schedule is important for accomplishing house-

TABLE 5 Rotated Factor Pattern from Principal Components Analysis

variables	factor 1	factor 2	factor 3	factor 4	factor 5	factor 6	factor 7	communality
1	.79	.04	.02	-.07	-.17	-.18	-.05	.69
2	.90	.02	-.03	-.03	-.02	.02	-.05	.82
3	.86	.05	.02	-.07	.05	-.04	-.09	.76
4	-.12	.08	.02	.15	.06	.85	-.10	.78
5	-.10	-.29	-.09	.06	.34	.44	.37	.55
6	-.13	.07	-.02	.06	.07	-.06	.87	.80
7	.03	.76	.09	-.17	.02	.00	.03	.62
8	.03	.78	.04	.00	-.10	.14	-.08	.65
9	.04	.62	.09	-.15	-.08	-.15	.06	.45
10	.04	.29	.76	-.06	-.16	-.05	.08	.71
11	-.03	-.01	.88	-.01	.06	.03	-.10	.80
12	-.06	-.39	-.04	.66	.16	.27	.18	.73
13	-.08	-.31	-.07	.67	.15	.37	.20	.76
14	-.06	-.06	-.01	.87	.10	-.08	-.02	.77
15	-.04	-.03	-.01	.87	.12	.07	-.06	.78
16	-.13	-.16	-.11	.30	.62	.24	.25	.64
17	-.11	-.19	.00	.01	.62	.24	.30	.58
18	.05	.10	-.02	.26	.79	-.17	-.24	.79

TABLE 6 Estimated Factor Pattern from Confirmatory Factor Analysis

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.69(17.7)						
2	0.87(23.1)						
3	0.79(20.8)						
4						0.34(7.1)	
5							0.74(11.2)
6							0.29(6.0)
7		0.68(14.6)					
8		0.59(12.8)					
9		0.54(11.8)					
10			1.00(8.7)				
11			0.41(6.8)				
12				0.87(25.5)			
13				0.89(26.5)			
14				0.58(14.8)			
15				0.63(16.4)			
16					0.92(13.7)		
17						0.53(9.7)	
18					0.36(7.7)		

* The t values are listed in the parentheses.

TABLE 7 Estimated Factor Correlations from Confirmatory Factor Analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Factor 1	1.00						
Factor 2		1.00					
Factor 3			1.00				
Factor 4	-0.15	-0.51	-0.22	1.00			
Factor 5	-0.19	-0.30	-0.25	0.58	1.00		
Factor 6	-0.36	-0.32	-0.21	0.69	0.83	1.00	
Factor 7	-0.25	-0.42	-0.21	0.50	0.59	0.90	1.00

hold duties, although 28 percent believe it is unimportant (Question 4). In response to Question 17, 43 percent of the respondents believe working from home will benefit their relationships with other household members, whereas 15 percent believe it will affect these relationships adversely.

With regard to the seventh attitude, preference toward working independently, most of the respondents (70 percent) like to work independently; only 8 percent dislike it (Question 5). The response to Question 6 also shows that most people (87 percent) would like to learn how to use new office equipment for their jobs.

Cross-Tabulated Tests

To identify the factors influencing employee attitudes toward telecommuting, the responses to each of the survey items in the attitudinal section were cross-tabulated with the individual and household characteristics, commuting trip attributes, and job characteristics of the respondent. Based on chi-squared tests of independence, summarized in Table 8, 14 of these variables were found to exert significant effects on the responses to at least one of the attitudinal questions. In general, most of the individual characteristics and commuting trip attributes, as well as some of the household characteristics, have statistically significant effects.

Employee expectations of the effect of telecommuting on family relations and job performance vary by gender. Fifty-two percent of the female respondents believe working from home will have a beneficial effect on their relationship with other household members, although only 33 percent of male respondents believe so. A larger percentage of the female (41 percent) versus the male (27 percent) respondents believe that they could accomplish more work at home. The educational

level of the respondent significantly influences the importance attached to working at the office. A higher percentage of respondents with only a high school education believe it is important to have frequent input from the supervisor or co-workers and to have immediate access to information or references at work, whereas a higher percentage of respondents with at least a bachelor's degree consider it important to attend short-notice meetings during work hours. Respondents with at least a medium level of computer proficiency are more inclined than others to work independently and believe their jobs are suitable for working from home. As expected, the number of children under 16 at home influences the respondent's expectation of the effect of telecommuting on his or her family. About 65 percent of the respondents with more than three children under age 16 at home believe that working from home will have a positive effect on their relationship with other household members; only 37 percent of the respondents without children believe so.

Commuting trip attributes, particularly trip distance and travel time, naturally influence the respondent's attitude toward transportation system performance and expectation of the effect of telecommuting on job performance and family. On the other hand, the number of stops for pickup or drop-off per week only significantly affects the latter.

An employee's experience with telecommuting affects his or her assessment of his or her job's suitability for telecommuting and the expectation of the effect of telecommuting on job performance. For instance, 75 percent of the current full-time telecommuters and 55 percent of the part-time telecommuters still believe their jobs are suitable for working from home several days per week, whereas only 35 percent of the respondents currently not telecommuting think so. Also, a higher percentage of the telecommuters (63 percent for full-time and 49 percent for part-time) believe that they can ac-

TABLE 8 Results of Chi-Square Tests of Independence Among Responses to Attitudinal Questions and Characteristics of Respondents

Variables	Attitudinal questions (See Table 4)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
gender	+				*	*		*		+						*	*	+
age	*			*						*	*			+		*	*	
education level						*	*	*	+	*		*	+		+		+	
computer skill					*	*							+		+			+
# of children under 16 at home		*	+	*					+									*
# of people with a driver's license				+	*													
# of personal computers at home													+	+	+			
trip distance	*	*	*			*						+				*	*	
AM travel time	*	*	*			*	*									+	*	
PM travel time	*	*	*	+		+				+								
AM stops for pick up/drop off per week																		*
PM stops for pick up/drop off per week													*					*
currently work from home	+												*	*	*	*	*	+
job category						*	*	*	*	+		*	*	*	*	+	+	*

+ : significant at the 0.05 level, but not at the 0.01 level

* : significant at the 0.01 level

comply more work by telecommuting, while only 32 percent of nontelecommuters believe so. None of the full-time telecommuters think telecommuting will increase their chance for promotion, although 17 percent of the part-time telecommuters and 4 percent of the nontelecommuters think so. Of course, job category also affects the respondent's assessment of his or her job's suitability for telecommuting. In general, a smaller percentage of respondents within Category 1 (president/vice president), Category 2 (manager/supervisor), and Category 10 (receptionist/secretary) believe their jobs are suitable for working from home. On the other hand, a higher percentage of respondents within Category 3 (writer/editor), Category 5 (agent), Category 6 (computer programmer), and Category 7 (data processing) indicate that their jobs are suitable for telecommuting.

STATED PREFERENCES FOR TELECOMMUTING ALTERNATIVES

This section discusses the responses to the questions regarding the employees' willingness to participate in different types of telecommuting options. After describing the various options and the responses, an exploratory analysis of some of the underlying factors influencing these responses is presented.

Discussion of Responses

Seven telecommuting program scenarios were defined in terms of who assumes the costs incurred to work from home and corresponding salary changes. Table 9 lists these alternative scenarios and the corresponding responses. For each alternative scenario, the employee was asked to state a preference in the form of one of the following responses: (a) working

from home everyday, (b) working from home several days per week, (c) possibly working from home, and (d) not to work from home. The response option to possibly work from home was unavailable for Scenario 4.

Scenario 4 (salary increases, no cost to employee) was designed to dominate all others, as confirmed by the results, with 86.1 percent of the respondents interested in telecommuting at least several days per week. Scenario 1 reflects the status quo (same salary, no cost to employee). Under this scenario, about 66 percent of the respondents will choose to work from home at least several days per week, with 22 percent indicating they do not exclude the possibility. The desire to telecommute is quickly dampened as employees are asked to incur some of the additional costs that may be required. The percentage of willing telecommuters drops to 38 percent if the employee has to pay for an additional phone line (Scenario 2), and to 29 percent if a computer must be purchased (Scenario 3). Apparently a 5 percent increase in salary may not be sufficient to compensate for some of these costs (Scenario 5), as suggested by the 28 percent categorical refusal to telecommute compared to about 12 percent under the status quo (Scenario 1).

Salary decreases certainly do not encourage telecommuting and appear to be even less tolerated than having to assume some of the costs of telecommuting. Under Scenario 6 (5 percent salary decrease, no additional cost to employee), the percentage of willing telecommuters decreases to 21 percent and further drops to 10 percent if one has to give up 10 percent of his or her salary (Scenario 7).

These results allow us to estimate the percentage of "hard core" telecommuters at no more than 15 percent and those that would not even think of telecommuting also at about 15 percent. This means that the participation of the majority of employees in a telecommuting program will depend on the specifics of the program, particularly its cost implications.

TABLE 9 Responses to Stated Preference for Telecommuting Program Scenarios

Telecommuting and Program Scenario	Responses (relative frequency, in percent)*			
	1	2	3	4
1. Salary stays the same; employer pays all costs	21.6	44.5	22.0	11.8
2. Salary stays the same; employee incurs cost of a new telephone number	11.9	25.8	33.4	28.9
3. Salary stays the same; employee buys a personal computer	9.2	16.0	31.8	43.0
4. Salary increases 5%; employer pays all costs	34.0	52.1	**	13.8
5. Salary increases 5%; employee pays part of the costs	16.2	28.2	27.8	27.8
6. Salary decreases 5%; employer pays all costs	7.9	12.8	21.2	58.1
7. Salary decreases 10%; employer pays all costs	5.2	5.0	12.4	77.4

- * 1: Would like to work from home everyday.
 2: Would like to work from home several days per week.
 3: Possibly would like to work from home.
 4: Do not want to work from home.

** This scenario only allowed three responses in the questionnaire.

Employees do not appear to value telecommuting sufficiently to take a pay cut for the privilege. Some may be willing to incur a small cost to acquire necessary equipment.

It can also be noted that under all program scenarios, more employees would rather telecommute only a few days per week instead of every day.

Cross-Tabulated Tests

The responses to the alternative telecommuting scenarios were also cross-tabulated with the same variables considered in the attitudinal analysis. The same 14 variables found to significantly influence employees' attitudes were also found to have effects on their stated preferences toward the various telecommuting program scenarios. Table 10 summarizes these results.

Consistent with the results of the attitudinal analysis, female respondents express a stronger preference for working from home than do male employees. For example, under the status quo Scenario 1, 73 percent of the female respondents stated that they would like to work from home at least several days per week, but only 58 percent of the responding males expressed such a preference. Again, this reflects the previous findings that more of the female respondents believe working from home will have a beneficial effect on their relationship with other household members and on their work productivity. Another result consistent with the attitudes uncovered earlier is that a larger percentage of respondents with at least medium proficiency in the use of computers would like to work from home. Similarly, respondents who own at least one personal computer at home express a stronger preference for telecommuting. For example, 60 percent of respondents with at least one computer would prefer to work from home under Scenario 5; only 40 percent of those with no home

computers would prefer to work from home under the same scenario.

Various household characteristics also affect the employee's preference for telecommuting. Under Scenario 1, 90 percent of the respondents with more than two children under 16 at home would like to work from home, although 63 percent of the respondents without children would like to do so also.

In general, commuting trip attributes do not affect the employee's assessment of his or her job's suitability for telecommuting. However, these attributes significantly affect the employee's stated preferences for the various telecommuting scenarios. A higher percentage of respondents with longer trip distances or travel time prefer to work from home than others. For example, under Scenario 1, 70 percent of the respondents with morning travel time greater than 19 min (the sample mean plus half of the standard deviation) would like to work from home, compared with 59 percent of the respondents with morning travel less than 9 min (the sample mean minus half of the standard deviation).

Also consistent with the attitudinal results, the employee's prior experience with telecommuting and job category affect his or her preference for telecommuting. A greater percentage of current full-time or part-time telecommuters indicate a preference for telecommuting than those without such experience. A smaller percentage of respondents within the management group (Categories 1 and 2) would like to work from home than those in other job categories. This result is consistent with the attitudinal analysis that found that a smaller fraction of these respondents believe their jobs are suitable for telecommuting. On the other hand, although employees in Categories 9 (field worker) and 10 (receptionist/secretary) had indicated that these jobs are not readily telecommutable, a large percentage of them still indicated that they would like to work from home.

TABLE 10 Results of Chi-Square Tests of Responses to Stated Preference Questions

Variables	Stated preference questions						
	1	2	3	4	5	6	7
gender	*			*			+
age	+	*		+	+	+	
education level				*	+		
computer skill	*	*	+	+	*		
# of children under 16 at home	+		*	*	*		
# people with a driver's license	*	*		+			*
# of personal computers at home			*		*		
trip distance	+	*	+	*			
AM travel time	*	+		*		+	
PM travel time	*	*		*		+	
AM stops for pick up/drop off per week	*	+		+	+		
PM stops for pick up/drop off per week	*	*		+	+	+	
currently work from home			*		*	+	+
job category	*	+	+	*			

+ : significant at the 0.05 level, but not at the 0.01 level

* : significant at the 0.01 level

CONCLUSION

Although telecommuting has been advocated for more than two decades, little information is available on the process by which employees decide to participate in telecommuting programs. To address this issue, a survey of employee attitudes toward telecommuting and stated preferences for alternative telecommuting program scenarios was conducted. The logic and structure of the attitudinal questions were intended to identify seven key attitudes toward telecommuting. The logic and structure of the questions were validated by PCA and CFA.

Although clearly limited in scope and size, the survey nonetheless has yielded useful insights into factors likely to influence employee participation in telecommuting programs and suggestions for the design of such programs. Such programs are likely to require some job redesign, because a majority of respondents consider it important to have frequent input and ready access to information presently available at the office. Telecommuting programs will also require some assurances to participants, and means of fair performance evaluation, to alleviate the belief expressed by 65 percent of the respondents that working from home will decrease their chances for promotion. Clearly, telecommuting will be more successful in most cases when working from home is limited to several days per week. Furthermore, success will depend on the economic implications of the program for the telecommuter; the majority of employees are not likely to be interested in trading salary for the opportunity to work from home, and most would expect the employer to pick up additional associated costs. However, there exists a small core of workers who would be willing to incur an economic cost to obtain the scheduling benefits of working from home.

As stated earlier, the analysis presented in this paper is exploratory in nature. Further analysis will establish formal mathematical relations between the employees' personal, household, and job characteristics, and their likelihood of participating in programs offering a particular set of attributes. In addition, it should be kept in mind that the broader potential benefits of telecommuting also require the adoption of such programs by employers. This aspect is also the subject of ongoing investigation.

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