

TELEWORK



AMERICA

Telework In the US

Telework America Survey 2000

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JALA International, Inc.

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ITAC

**International Telework
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Executive Summary

This is the Year 2000 edition of a continuing series of reports in the Telework America series covering the growth and characteristics of telework in the United States. We find that there were 16.5 million regularly employed US teleworkers, age 18 years or older, in late July 2000, according to the national telephone survey data collected by the Behavior Research Center. The survey comprised 1,877 in-depth telephone interviews constituting a random sample of households proportionally allocated throughout the United States.

The research survey, sponsored by AT&T, indicates that while more than half of the teleworkers surveyed have been working remotely for at least three years, 17 percent are new teleworkers with one year or less experience in teleworking, amounting to about 2.8 million new teleworkers.

The survey and our analyses covered basic demographic characteristics, the various modes of telework and forms of employment of teleworkers, impacts of teleworking on productivity, job satisfaction, residential relocation decisions, technology uses, commuting patterns, and the environment. These analyses confirm prior reports that teleworkers have higher levels of education, are more productive, earn more, have larger homes, commute farther when they do commute, and are heavier users of information technology than non-teleworkers. We found that teleworkers do not contribute to urban sprawl when they change the location of their homes.

We examined the level of unfulfilled desire to telework by both teleworkers and non-teleworkers—substantial in both cases—indicating that there is considerable room for growth of teleworking in the US. Our forecast of the growth of telework in the US suggests that there will be 30 million employed US teleworkers by yearend 2004.

We also compared the US data with that of a comparable 1999 survey in Europe (the ECaTT¹ survey), covering the 15 member nations of the European Union. That comparison showed that the US is surely ahead of the EU countries as a whole in adopting telework. However, the US is behind three EU countries (Finland, Netherlands, and Sweden) in per capita telework participation. We were also able to forecast the growth of telework in the EU, using the results of the ECaTT survey and a 1994 survey (TELDET) conducted by the same group. The result is that the 15 EU countries may reach 40 million teleworkers before the US does.

While technology has rarely been a fundamental barrier to teleworking, the phenomenal spread in information technologies over the past decade, particularly personal computers and the Internet, has crumbled many of the remaining physical and sociological barriers to its broader adoption. Essentially every industrial sector in the US has teleworkers. Every region in the US has teleworkers, although the New England states currently are in the lead in terms of the proportion of teleworkers in their populations.

¹ Electronic Commerce and Telework Trends. Compiled by empirica GmbH in Bonn.

Key Findings

Numbers of teleworkers

There are 16.5 million regularly employed teleworkers in the US who telework at least one day per month and are at least 18 years old. Slightly more than 17%, 2.8 million, of these are new teleworkers. There are 9.3 million US teleworkers who telework at least one full day per week. Details are in Appendix 1. While a few years ago most teleworkers worked for small to medium-sized organizations, now half of them work for organizations with at least 1,500 employees.

Teleworker types and roles

We have categorized teleworkers into three main types, based on their teleworking location (while they are teleworking): solely home-based (89%); solely telework-center-based (7%); and both home- and telework center-based (4%). There are also four forms of employment included in the survey: Employees (54% of home-based teleworkers); contract workers (13% of home-based teleworkers); teleworking operators of home businesses (9% of home-based teleworkers); and self-employed teleworkers (27%). Comparable percentages for telework center teleworkers are: 61% employees; 18% contract workers; 4% home business operators; and 18% self-employed. The growth rates for these groups are 17% for employees, 22% for contract workers, 25% for home business operators, and only 11% for the self-employed.

Demographics

There are teleworkers in every region of the US, although the highest proportions are in the New England, Mountain, and Pacific states (in order of decreasing per capita density). Males are predominant among home teleworkers (65% as contrasted to 44% of the non-teleworkers in the group surveyed) although there were proportionally more females (20%) than males (15%) who were new home teleworkers in the preceding year. Telework-center-only teleworkers are closer to the non-teleworkers in the gender distribution: 48% male. However, the growth rate in numbers of center-only teleworkers is 32%. The average home-only teleworker is in his/her early 40s, slightly older than the average among non-teleworkers surveyed. Center-only teleworkers, on the other hand, are a younger group, averaging in their early 30s—and exactly half of them single—while only about 20% of the other teleworkers (and 27% of the non-teleworkers) are single. 60% of the non-teleworkers surveyed have at least some college education, as contrasted to 82% of home-based teleworkers and 79% of center-only teleworkers. Median annual income for home-only teleworkers is in the lower \$50,000 range, as contrasted with the lower \$30,000 range for non-teleworkers.

Teleworking intensity

On average, both home-based and center-based teleworkers telework about 20 hours per week, although home-based teleworkers tend to telework more during non-business hours. 30% of the telework center teleworkers are there at least 35 hours per week. About 20% of the home-based teleworkers telework at least 35 hours per week, although less than 15% do it entirely during normal business hours. More than half the teleworkers have been teleworking at least three years; 17% are new teleworkers with one year or less experience teleworking.

We also asked non-teleworkers whether they would like to telework at home. 39% responded positively but only 31% felt that their employers would allow it. Notably, 10% of the non-teleworkers considered that the ability to telework from home in a potential new job would have a moderate to decisive influence on their decision to make the move.

Where, what, and how

Home-based teleworkers also have larger homes, on average, than non-teleworkers; the difference amounting to about 500 square feet. The most popular place for an office in these larger homes is a spare bedroom, with the living room a distant second. The primary home telework activity is computer work (55% of total activities), followed by telephoning, reading, and—averaging 7% of the time—face-to-face meetings. These averages are for the entire group of home teleworkers; they vary with the principal occupation of the teleworker, with managers, professionals, and technicians using computers most heavily.

One of the issues in designing telework programs is that of teaching teleworkers to break up their tasks into two groups: those that are best done in the traditional office and those that are location independent—and therefore teleworkable. The survey data show a positive correlation between the degree to which teleworkers allocate tasks specifically for teleworking and their productivity changes.

Although telecommuting is usually associated with local activities, including proximity of both telecommuter and telemanager, only 62% of the employee-teleworkers reported that their direct supervisor was local. In 19% of the cases the supervisor was not even in the same state as the teleworker, although we had no reports of international teleworker-telemanager teams.

Commuting, urban sprawl, and the environment

80% of the home-only teleworkers also commute to work on days they are not teleworking. Their one-way commute distance averages 19.7 miles—versus 13.3 miles for non-teleworkers. The teleworkers' daily round trip commute times average 63 minutes versus 45 minutes for non-teleworkers. Teleworkers who work at telework centers have commute distances and times comparable to the non-teleworkers. At least 80% of all the workers surveyed drive alone to work when they commute. All the workers average between 4.5 and 5 miles extra for errands on commute days, although the median distance for home-only teleworkers is 1 mile.

One potential ill effect of telework that is refuted by this study is that it might contribute to urban sprawl. The average home-only teleworker does live almost half again as far from work as the rest of those surveyed. However, we asked the home-teleworkers whether they had relocated their residences—and the extent to which

telework had influenced their decisions. This is consistent with our prior studies of individual organizations.²

There is a positive environmental effect of telework: a reduction of the number of cars on the road, with a concomitant reduction in air pollution. Although we did not ask whether a home teleworker's car was used for other purposes on telework days, our experience with individual projects indicates that it either was not used or was used by another family member for a normal family trip. That is, there was not an offsetting use of the car. Assuming this to be the case we find that the average home teleworker reduces air pollution by 5 pounds of reactive organic gases, 7 pounds of nitrogen oxides, 3 pounds of particulates, and 2,360 pounds of carbon dioxide annually.

Technology use

As one might expect, teleworkers also tend to be heavier users of computer technology than workers in general. The average ownership pattern for home-only teleworkers is one PC for work, another for non-work purposes, 2.6 TVs, and 1.9 VCRs, as contrasted to an average of 0.8 PCs for work, 0.5 for non-work, and about the same number of TVs and VCRs for non-teleworkers. Yet, the top three non-computer technologies in use by teleworkers, in decreasing order of popularity, are the telephone, pager, and fax. Half the teleworkers use email at least 3 hours per week, but the average is 7 hours because of some heavy users. 46% of the teleworkers pay for both their equipment and its maintenance, with the employer covering all costs in only 29% of the cases. Less than 20% of the teleworkers get intensive training in the use of their technology. Slightly more than three-quarters of the home-only teleworkers have analog modems to connect them to their employers or the Internet, with DSL leading (9%) among the wideband digital alternatives.

The bottom line

One of the first questions a CEO will ask when the possibility of a telework program comes up for discussion is: what's the effect on the bottom line? High on the list is the reason why telework was considered to begin with. The most popular reasons are space savings, productivity improvements, and personnel retention and/or recruiting. In these days of low unemployment and high demand for skilled workers, personnel retention or recruiting often rises to the top of the wish list.

We were not able to verify productivity changes with supervisors but the self-reported productivity improvement of home-based teleworkers averages 15% (the figure is 30% for telework-center-based teleworkers). This translates to an average annual bottom line impact of \$9,712 per teleworker. With 16.5 million teleworkers in the US that works out to an annual national impact exceeding \$160 billion.

We also were not able to determine how much space is saved at their employers' facilities as a result of teleworking. However, 17% of employee-teleworkers and 19% of contract teleworkers (12% of all home-teleworkers or 1.6 million teleworkers) share their workspace with others at their employer's facility. Assuming the average home teleworker shares space with only one other person that is a direct reduction of 1.6 million office spaces nationwide.

Many, if not most, experienced teleworkers are determined to continue teleworking. Therefore, the ability to telework is important to them not only as a criterion for

² For example, see Jack M. Nilles. "Telecommuting and urban sprawl: mitigator or inciter?" *Transportation* **18**: 411-432, 1991.

staying in their current job but also as a prerequisite for a new job. We asked the teleworkers whether they had seriously considered changing jobs during the past year and, if so, the extent to which the ability to telework caused them to stay. The ability to telework was a moderate to decisive influence for 13% of those queried. If we spread the impact over the whole group of home-based teleworkers (assuming that it costs a year's salary to replace a teleworker) the mean turnover reduction effect of teleworking is \$4,857 per teleworker—or \$80 billion nationwide.

In her September 27th column in *The Wall Street Journal* Sue Shellenbarger pointed out the costs to employers of having employees defect when faced with a transfer to another location. The cost was pegged at from \$100,000 to \$200,000 per employee, based on data from a study at the Haas Center for Business Research at the University of West Florida. Although our number is much more conservative, the issues around families not wishing to uproot themselves should act to focus more attention on telework as a less costly alternative to doing business.

The US versus Europe

Although teleworking has long been considered an American specialty, Western Europe, with its larger workforce, may be catching up fast. Although we do not have data for the year 2000, we can compare current results with a 1999 survey of the 15 European Union countries. In 1999 these countries had 6 million regular teleworkers (i.e., those teleworking at least one full day per week) while the US had 9.3 million. The world leader in the number of regular teleworkers, as a fraction of the workforce, is Finland (10.8%), followed by the Netherlands (8.3%), Sweden (8.0%), and the US (6.8%). If we add those who telework less than one full day per week the EU countries had 9 million teleworkers in 1999 versus the 16.5 million in the US in 2000.

What next?

I have used JALA's forecasting model to estimate the number of teleworkers in both the US and the EU countries for the next decade. If the model is correct there should be 30 million US teleworkers around the end of 2004 and 40 million near yearend 2010. The EU countries, if they maintain their apparent growth rates, may also hit 30 million teleworkers by yearend 2004 and arrive at 40 million three years ahead of the US.

Demographics: Teleworkers and Non-Teleworkers

The Telework America 2000 Teleworker Survey covered 1877 individuals within the United States. Once the respondents signified that they were employed, the survey began with a definition of telework. This was followed by a query as to whether the respondent had ever heard of it. The definition was:

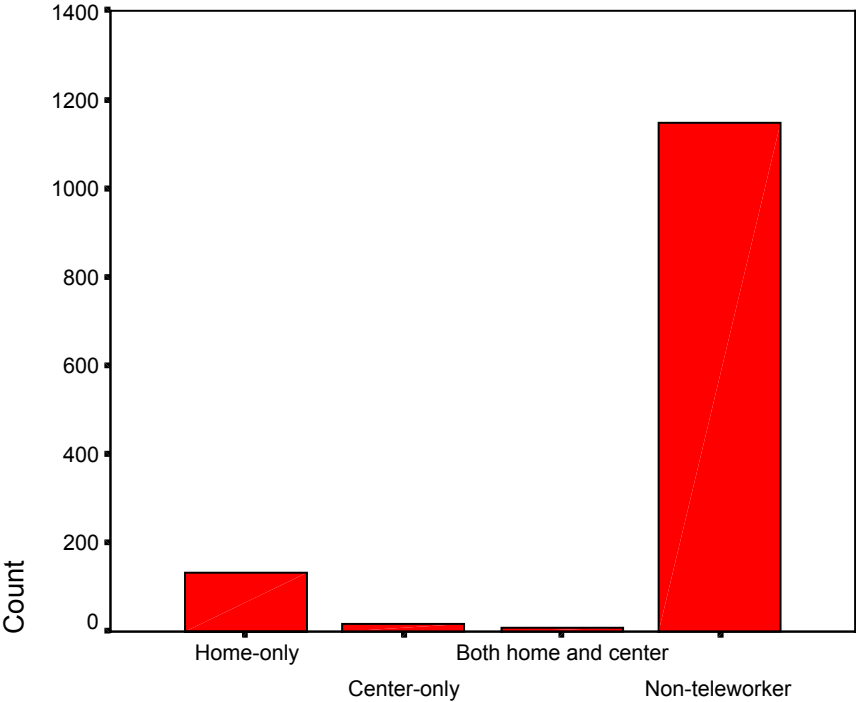
With the help of modern technologies many types of work can now be done at home using telephones, faxes and computers. This is called teleworking or telecommuting. Six-tenths of a percent of the respondents didn't know if they had heard of teleworking or telecommuting. Of the remaining 1866 respondents, 74.3% said they had heard of it.

To clarify the options we have separated the respondents into 4 groups:

- 1. Teleworkers whose telework is solely at home;
- 2. Teleworkers who telework both at home and a telework center;
- 3. Teleworkers who telework solely at a telework center; and
- 4. Workers who do not telework.

The relative numbers of these groups are shown in Figure 1.

Figure 1: Relative sizes of worker populations



The original design of the survey was to develop a set of about 1800 respondents, chosen at random throughout the US in proportion to the populations in the 9 census districts. Only employed persons 18 years of age or more were selected for the survey. Because we also wanted to get at least 250 teleworkers in the survey, the pure random sample portion of it was stopped after 1309 individuals were surveyed; after that a quota was imposed so that the remaining samples were not entirely random—some non-teleworkers responses were bypassed, although the regional allocations were preserved. In the pure random sample portion of the survey teleworkers of all sorts constitute 12.2% of the total workforce sample analyzed. According to the Bureau of Labor Statistics, the US employed civilian workforce in July 2000 was 135,200,000. Therefore, I estimate that there were 16,526,000 US teleworkers at the beginning of August 2000, when the survey was completed. Details, including a brief discussion of estimation issues, are in the [Appendix on Methodology](#)

Figure 2: Geographical distribution of teleworkers and non-teleworkers by region

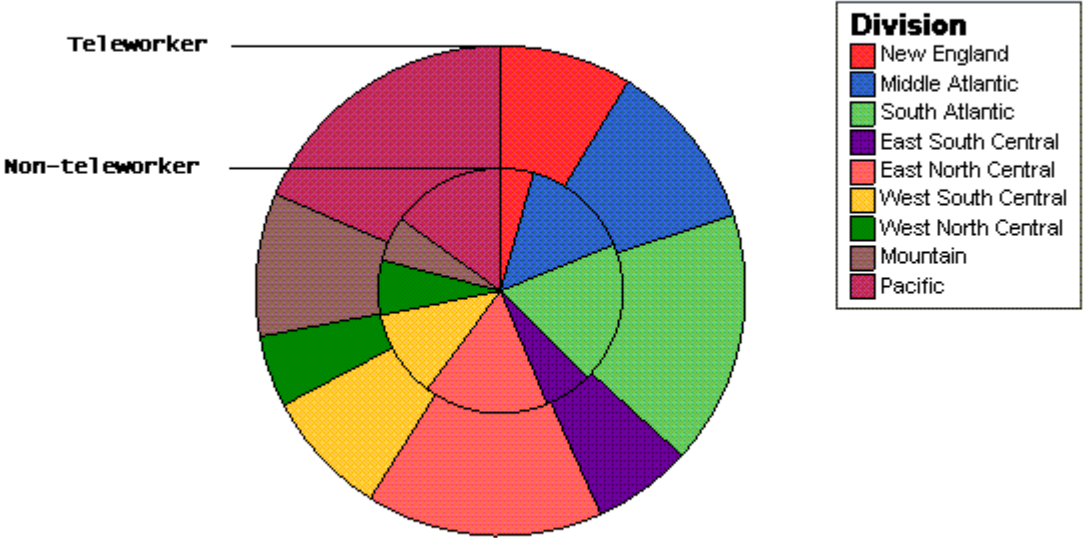


Table 1: Regional per capita distribution of teleworkers

		Frequency	Percent	Cumulative Percent
Valid	New England	24	8.7	8.7
	Middle Atlantic	31	11.3	20.0
	South Atlantic	46	16.7	36.7
	East South Central	18	6.5	43.3
	East North Central	43	15.6	58.9
	West South Central	23	8.4	67.3
	West North Central	13	4.7	72.0
	Mountain	26	9.5	81.5
	Pacific	51	18.5	100.0
	Total	275	100.0	

Tables 1 and 2 show the percent, in each region of the US, of the total teleworker and non-teleworker populations, respectively. Figure 2 compares the relative regional proportions of the teleworker and non-teleworker populations.

Table 3 gives the ratio between the percent of teleworkers and the percent of non-teleworkers in each region. The relatively high-density regions are New England, the Mountain region (Idaho through New Mexico), and the five Pacific states. Conversely, the Middle Atlantic, South Atlantic, and western Midwest states have lower than average proportions of teleworkers.

Table 2: Regional distribution of non-teleworkers

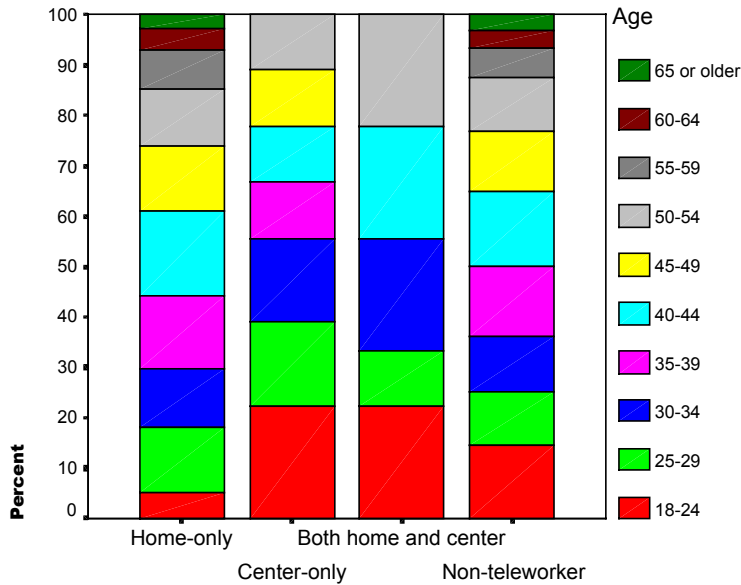
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid New England	70	4.4	4.4	4.4
Middle Atlantic	232	14.5	14.5	18.9
South Atlantic	298	18.6	18.6	37.5
East South Central	101	6.3	6.3	43.8
East North Central	263	16.4	16.4	60.2
West South Central	186	11.6	11.6	71.8
West North Central	116	7.2	7.2	79.0
Mountain	95	5.9	5.9	85.0
Pacific	241	15.0	15.0	100.0
Total	1602	100.0	100.0	

Table 3: Relative teleworker density by region

	Teleworker Ratio
New England	2.0
Middle Atlantic	0.8
South Atlantic	0.9
East South Central	1.0
East North Central	1.0
West South Central	0.7
West North Central	0.7
Mountain	1.6
Pacific	1.2

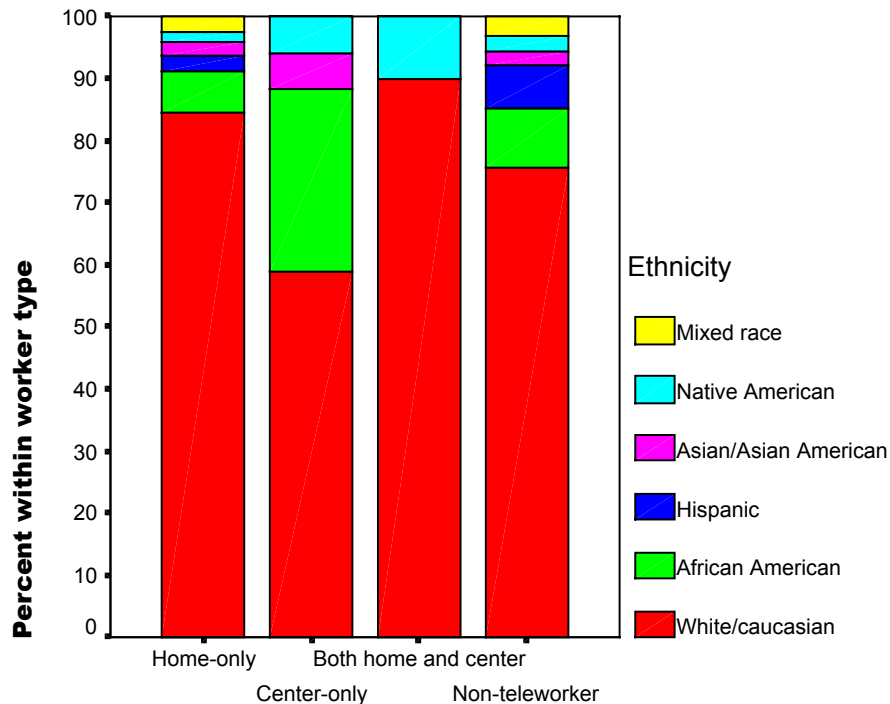
The age distribution of these groups is shown in Figure 3. As expected, the age distribution of home-based teleworkers is quite similar to that of non-teleworkers except for the 18 to 24-year old portion. Our experience has been that employers prefer to confine the home telework option to seasoned employees.

Figure 3: Age distribution by worker type



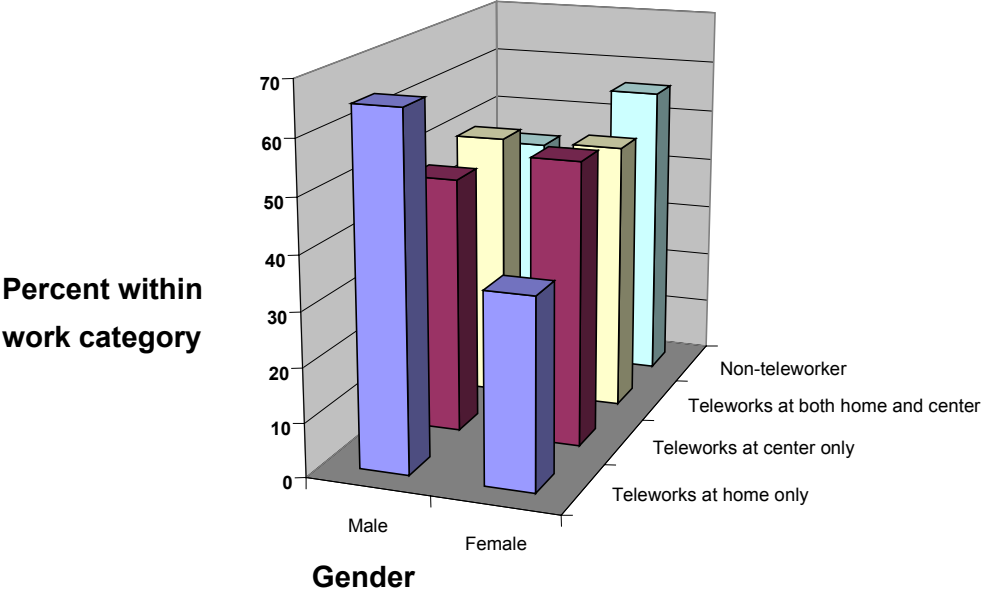
Similarly, telework center employees tend to be in the younger age groups—and not in the over-55 groups, as is demonstrated in the figure. Figure 4 shows the ethnic origin distribution of the respondents. Teleworkers are predominantly White/Caucasian, compared to the workforce in general, except those who telework only at telework centers, where there is a disproportionate number of African Americans. An apparent surprise is in the proportion of Native Americans in telework centers.

Figure 4: Ethnic origin distribution by worker type



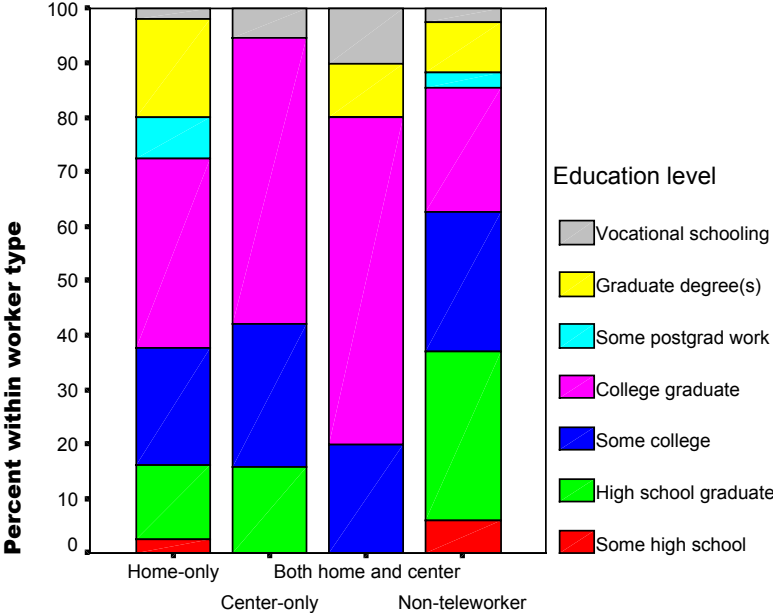
The survey results showed a higher proportion of female workers than males in the workforce. Data from the Bureau of Labor Statistics for the year 1999 shows the opposite. Possibly more females than males respond to telephone surveys. In any case, the results are shown in Figure 5. In general there is a significantly higher than average proportion of male teleworkers, particularly those who telework solely from home.

Figure 5: Gender distribution by worker type.



Each of the three groups of teleworkers contains a majority of members who, in terms of their educational achievements, are at least college graduates. Figure 6 shows the distribution.

Figure 6: Highest level of education by worker type



Home-only teleworkers tend more to be married than either non-teleworkers or those teleworkers who work at telework centers. Figure 7 shows the results. This, too, is expected since the relative isolation of home telework can reduce the chances of social interaction for young singles. Married teleworkers, on the other hand, often see teleworking as an attractive means of improving family life while maintaining career options.

Figure 7: Marital status by worker type

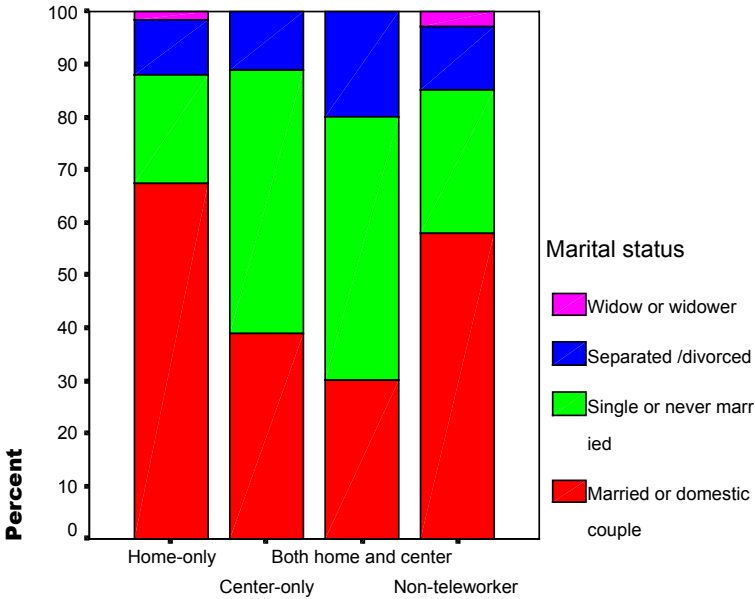
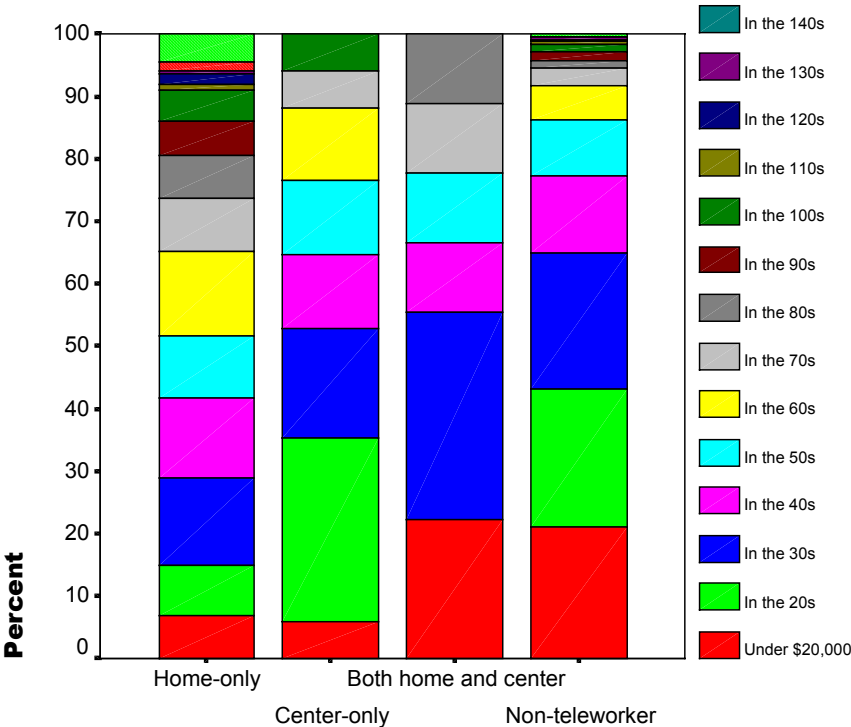


Figure 8: Annual personal income by worker type



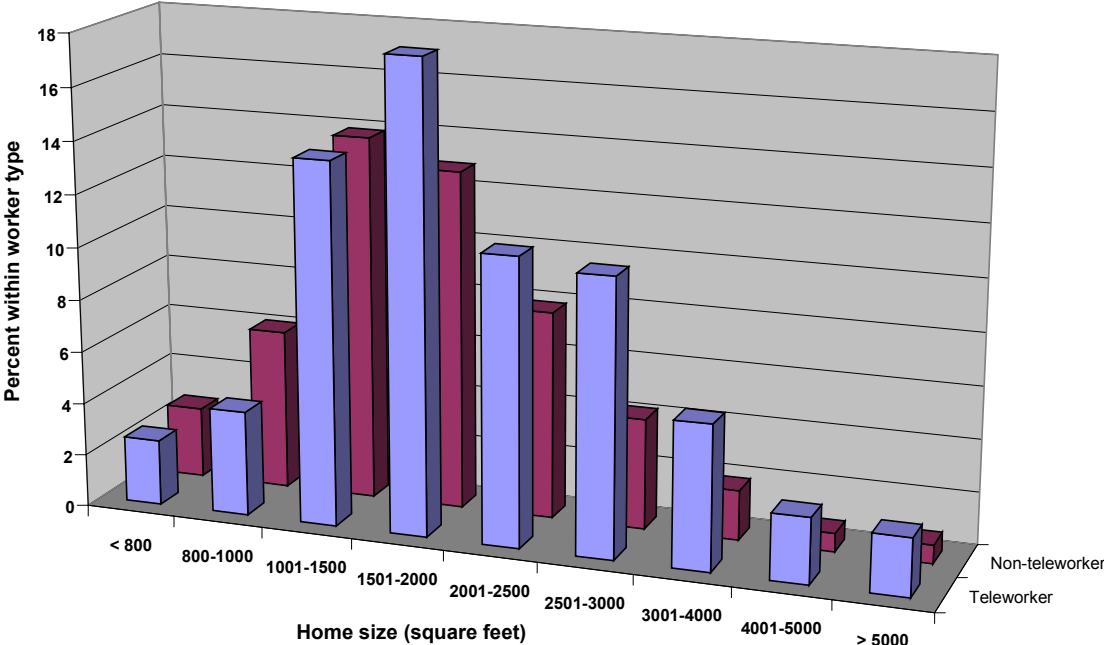
Teleworkers also have higher incomes as a group than non-teleworkers, with home-only teleworkers leading, as shown in Figure 8. Median annual income for home-only teleworkers is in the lower \$50,000 range, as contrasted with the lower \$30,000 range for non-teleworkers.

Table 4: Annual personal income by worker type

	Under \$20,000	In the 20s	In the 30s	In the 40s	In the 50s	In the 60s	In the 70s	In the 80s
Home-only	7.0%	8.0%	13.9%	12.9%	10.0%	13.4%	8.5%	7.0%
Center-only	5.9%	29.4%	17.6%	11.8%	11.8%	11.8%	5.9%	
Both home and center	22.2%		33.3%	11.1%	11.1%		11.1%	11.1%
Non-teleworker	21.0%	22.0%	22.0%	12.2%	9.1%	5.3%	2.9%	1.2%
	In the 90s	In the 100s	In the 110s	In the 120s	In the 130s	In the 140s	In the 150s	\$160,000 or higher
Home-only	5.5%	5.0%	1.0%	1.5%	.5%		1.5%	4.5%
Center-only		5.9%						
Both home and center								
Non-teleworker	1.3%	1.4%	.4%	.4%	.3%	.1%	.1%	.4%

Teleworkers also tend to have larger homes than non-teleworkers. Although a large portion of both groups declined to answer the home size question, the overall pattern shows in Figure 9. Part of the reason may be the fact that the teleworkers have higher income and, therefore, can afford larger homes. Conversely, those with larger homes can more readily find relatively isolated space for home offices. The average home teleworker has about 500 square feet (46 m²) more space at home than does a non-teleworker.

Figure 9: Reported sizes of teleworkers' and non-teleworkers' homes



Teleworkers tend to be slightly more prone to be urban dwellers—or less prone to live in the countryside—as is shown in Table 5. This is as one might expect, given the extra pressures to avoid commuting for urban dwellers.

Table 5: Size of worker residence communities

	Teleworker	Non-teleworker	Total
City	57.7%	51.2%	52.2%
Town	25.0%	24.5%	24.6%
Village	4.4%	4.3%	4.3%
Rural area	12.9%	19.9%	18.9%
Total	100.0%	100.0%	100.0%

The Teleworking Spectrum

Telework covers a wide range of possibilities, from the worker who occasionally works at home (our minimum for inclusion is at least one day per month) to those who work at home full-time—and in some cases more than “full time.” Furthermore, we have included workers who work at telework centers, either part of full-time and either only at a center or at both home and center. Figure 10 shows the split between these major types of telework. Figure 11 shows how these types, including non-teleworkers vary from region to region in the US. There were no responses in the New England, Middle Atlantic, and East South Central states from people who teleworked both from home and a telework center.

Figure 10: Distribution of types of telework.

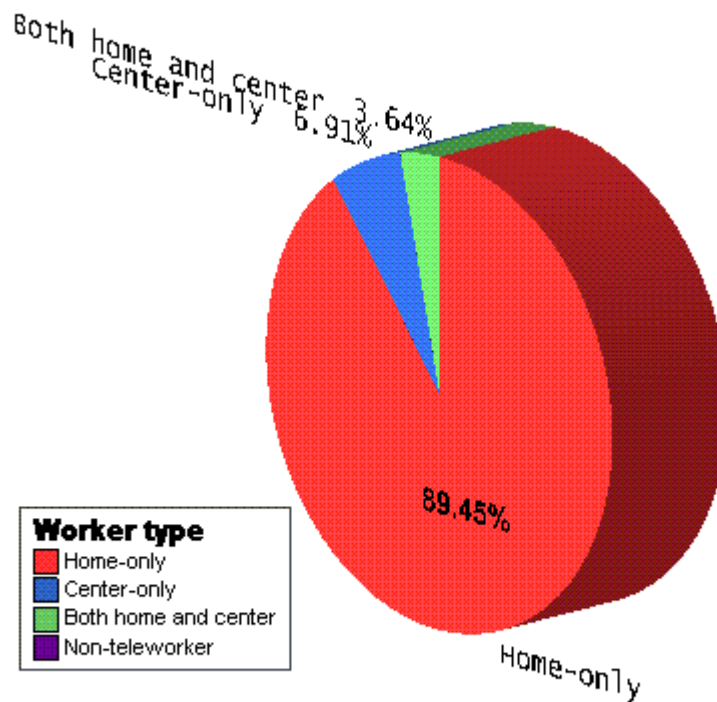
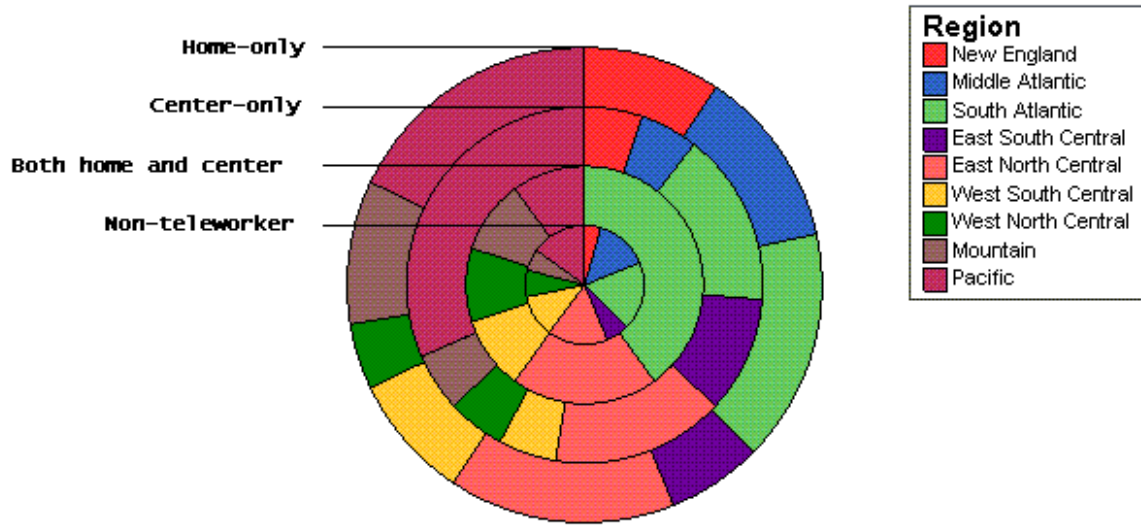
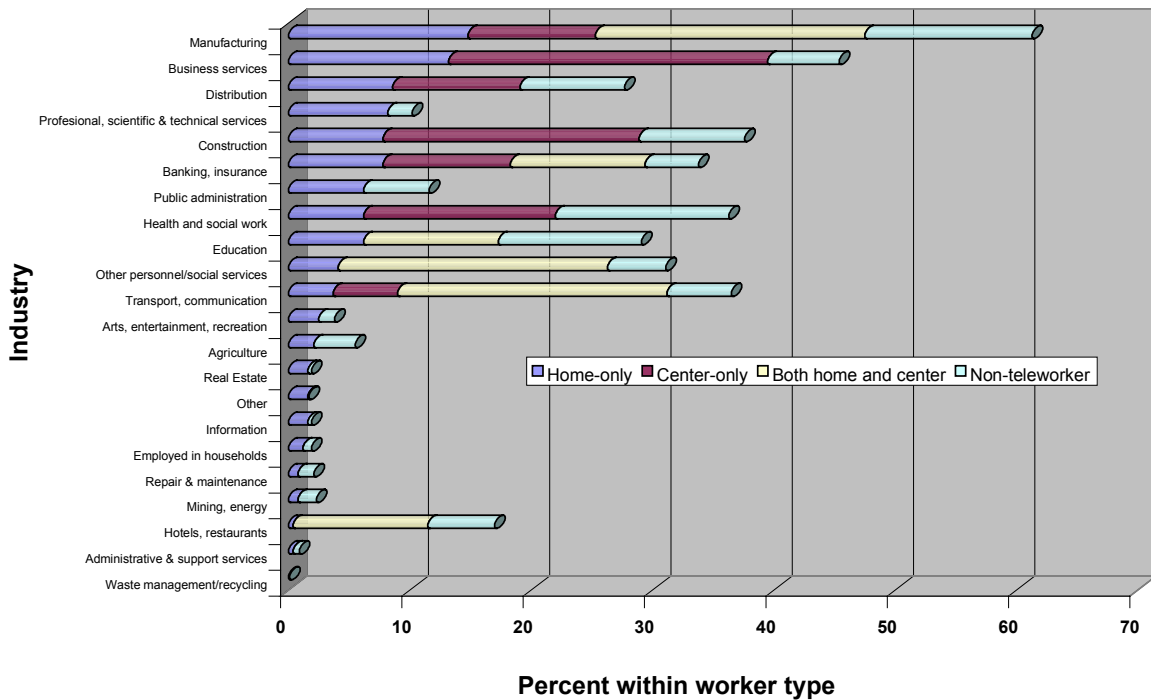


Figure 11: Regional distribution of non-teleworkers and teleworker types



A frequent question about teleworking is: what industries are best for teleworking? Figure 12 shows the distribution of these four types of workers among the industries they quoted. Note that the only industry in which we did *not* find teleworkers was waste management.

Figure 12: Distribution of surveyed workers in their employers' industries



Home-based Telework

The largest category of teleworkers comprises those who telework solely at home. This does not mean that they only work at home; just that all of their teleworking is home-based. Furthermore, although the majority of teleworkers are conventional employees of a larger organization, many are contract workers or at least partially self-employed. Figure 13 and Table 6 show the details for the primary choices of the respondents.

Figure 13: Primary work roles for home teleworkers

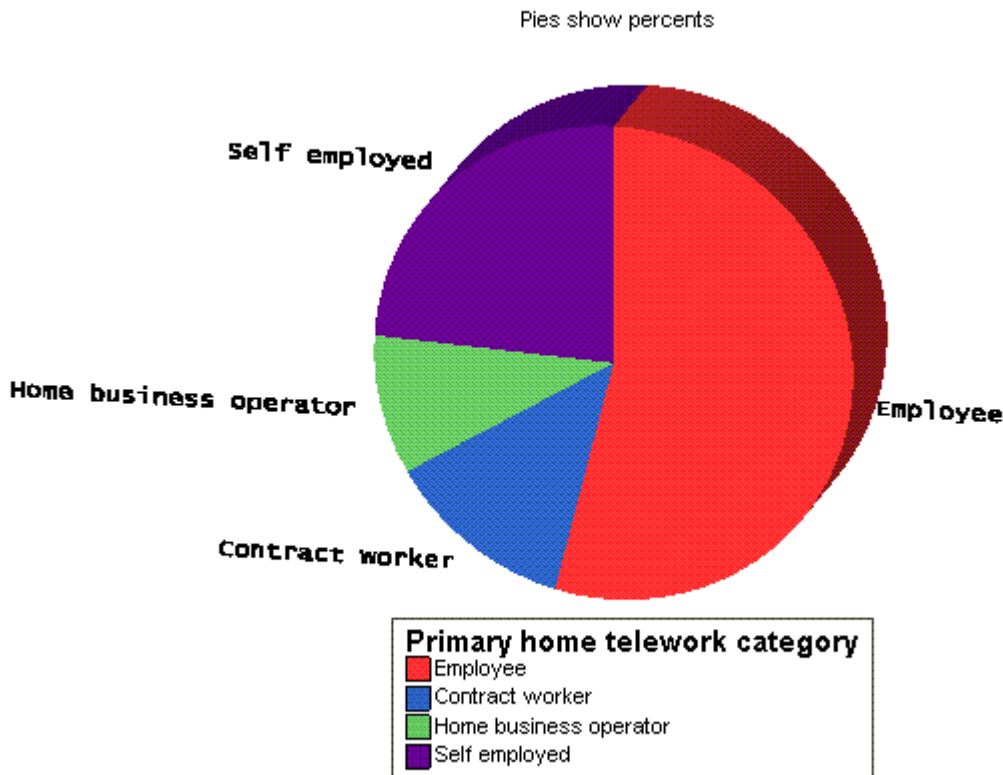


Table 6: Primary home teleworker work roles

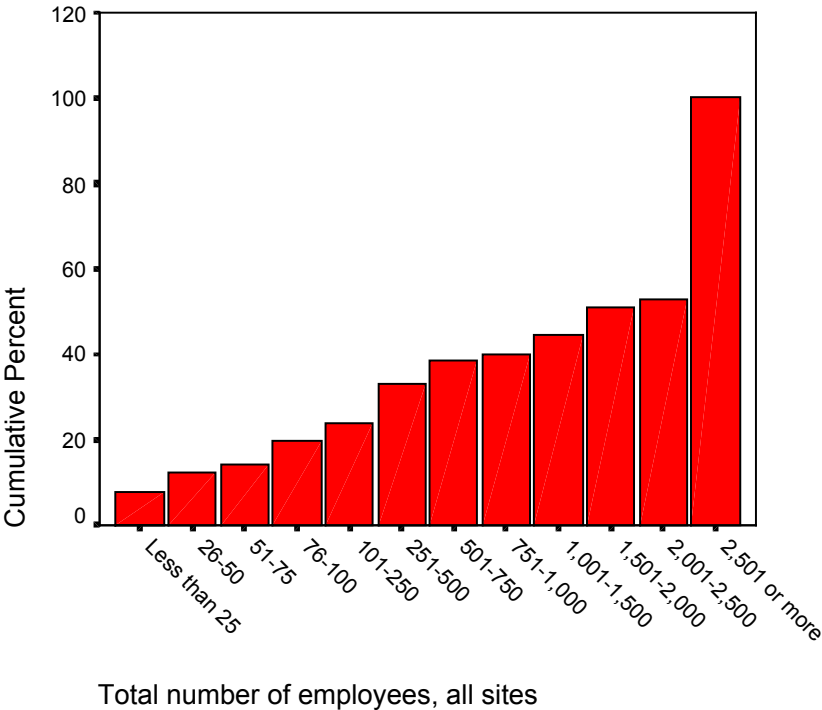
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Employee	137	53.5	53.9	53.9
Contract worker	32	12.5	12.6	66.5
Home business operator	24	9.4	9.4	76.0
Self employed	61	23.8	24.0	100.0
Total	254	99.2	100.0	

Basics

For whom do home teleworkers work? A few years ago most home teleworkers were said to work for small to medium-sized organizations. This year we find that half of

the home-only teleworkers work for organizations with at least 1,500 employees, as is shown in Figure 14. The larger employers may have been slow to adopt teleworking but they are now leading in the adoption of telework practice.

Figure 14: Total numbers of employees among employers of teleworkers



A fundamental question is the frequency with which teleworkers telework. Figure 15 and Table 7 show the distribution of these frequencies in terms of teleworking during “normal business hours.” The reason for this particular phrasing of the question (On average, how many days per month do you work at home during normal business hours) was to ensure that we were concentrating on teleworkers, not people who are simply taking extra work home with them after a day at the office. The mean value is 10.52 days per month; the median is 6 days per month and the mode is 20, a distinctly non-normal distribution. Note that a few teleworkers report working essentially every day of the month, with 12% reporting at least four full monthly workweeks!

Figure 15: Home telework frequencies

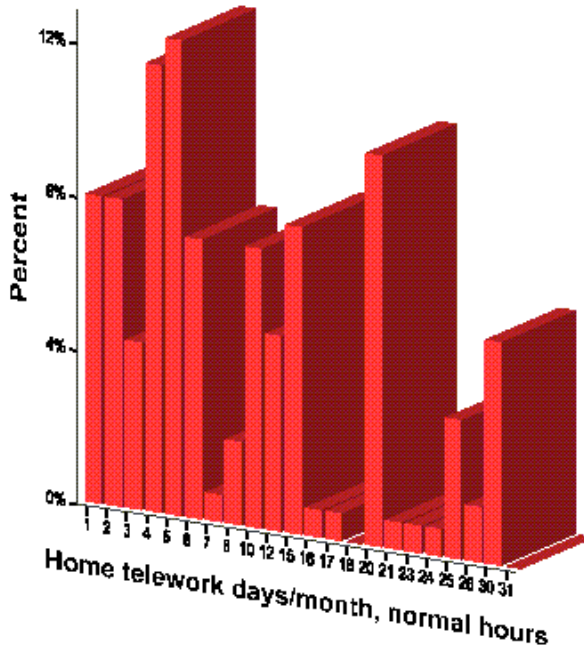


Table 7: Home telework frequencies

Home telework days/month, normal hours

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	30	11.7	13.2
	2	20	7.8	21.9
	3	10	3.9	26.3
	4	22	8.6	36.0
	5	27	10.5	47.8
	6	11	4.3	52.6
	7	1	.4	53.1
	8	6	2.3	55.7
	10	14	5.5	61.8
	12	7	2.7	64.9
	15	16	6.3	71.9
	16	1	.4	72.4
	17	1	.4	72.8
	18	1	.4	73.2
	20	32	12.5	87.3
	21	1	.4	87.7
	23	1	.4	88.2
	24	1	.4	88.6
	25	9	3.5	92.5
	28	2	.8	93.4
	30	14	5.5	99.6
	31	1	.4	100.0
Total	228	89.1	100.0	
Missing Don't know	19	7.4		
Refused	9	3.5		
Total	28	10.9		
Total	256	100.0		

The distribution of telework hours per week shows a similar pattern, as seen in Table 8. About 20% of the home-based teleworkers telework at least 35 hours per week, although less than 15% do it entirely during normal business hours.

Table 8: Home telework hours per week

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1	9	3.3	3.7	3.7
2	16	5.8	6.6	10.3
3	7	2.5	2.9	13.2
4	15	5.5	6.2	19.3
5	15	5.5	6.2	25.5
6	3	1.1	1.2	26.7
7	3	1.1	1.2	28.0
8	17	6.2	7.0	35.0
10	22	8.0	9.1	44.0
12	11	4.0	4.5	48.6
13	1	.4	.4	49.0
14	1	.4	.4	49.4
15	13	4.7	5.3	54.7
16	5	1.8	2.1	56.8
18	1	.4	.4	57.2
20	24	8.7	9.9	67.1
21	1	.4	.4	67.5
24	1	.4	.4	67.9
25	7	2.5	2.9	70.8
26	1	.4	.4	71.2
27	1	.4	.4	71.6
28	1	.4	.4	72.0
30	14	5.1	5.8	77.8
32	4	1.5	1.6	79.4
35	3	1.1	1.2	80.7
40	16	5.8	6.6	87.2
45	3	1.1	1.2	88.5
48	1	.4	.4	88.9
50	7	2.5	2.9	91.8
55	1	.4	.4	92.2
56	1	.4	.4	92.6
60	11	4.0	4.5	97.1
70	4	1.5	1.6	98.8
80	2	.7	.8	99.6
90	1	.4	.4	100.0
Total	243	88.4	100.0	

Figure 16 shows the distribution in the tenure of the teleworkers in home-based teleworking. The details are shown in Table 9. More than half the teleworkers have been teleworking at least 3 years. Also, 17% of the home-based teleworkers have been teleworking one year or less.

Figure 16: Length of tenure of home-based teleworkers

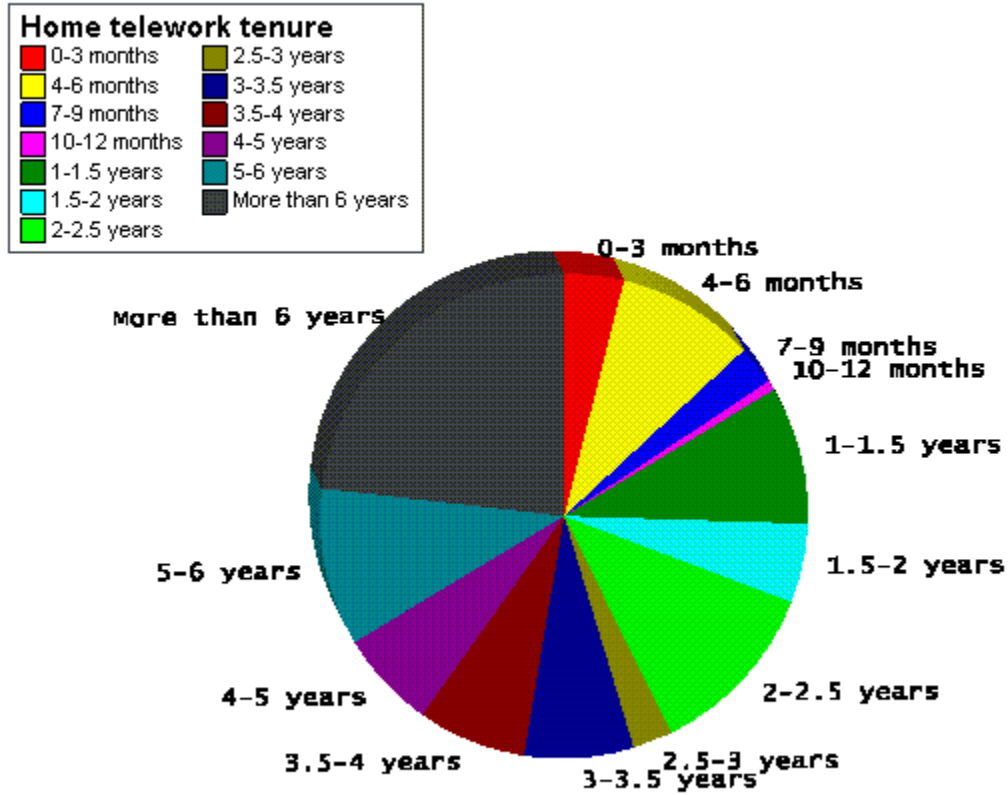
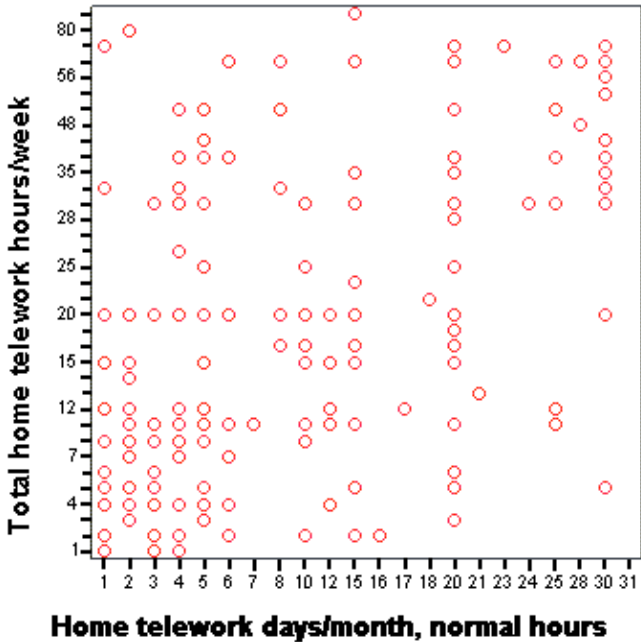


Table 9: Length of tenure of home-based teleworkers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-3 months	16	6.3	6.4	6.4
	4-6 months	18	7.0	7.2	13.6
	7-9 months	4	1.6	1.6	15.2
	10-12 months	4	1.6	1.6	16.8
	1-1.5 years	23	9.0	9.2	26.0
	1.5-2 years	11	4.3	4.4	30.4
	2-2.5 years	27	10.5	10.8	41.2
	2.5-3 years	8	3.1	3.2	44.4
	3-3.5 years	15	5.9	6.0	50.4
	3.5-4 years	12	4.7	4.8	55.2
	4-5 years	16	6.3	6.4	61.6
	5-6 years	30	11.7	12.0	73.6
	More than 6 years	66	25.8	26.4	100.0
Missing	Don't know	5	2.0		
	Refused	1	.4		
	Total	6	2.3		
Total		256	100.0		

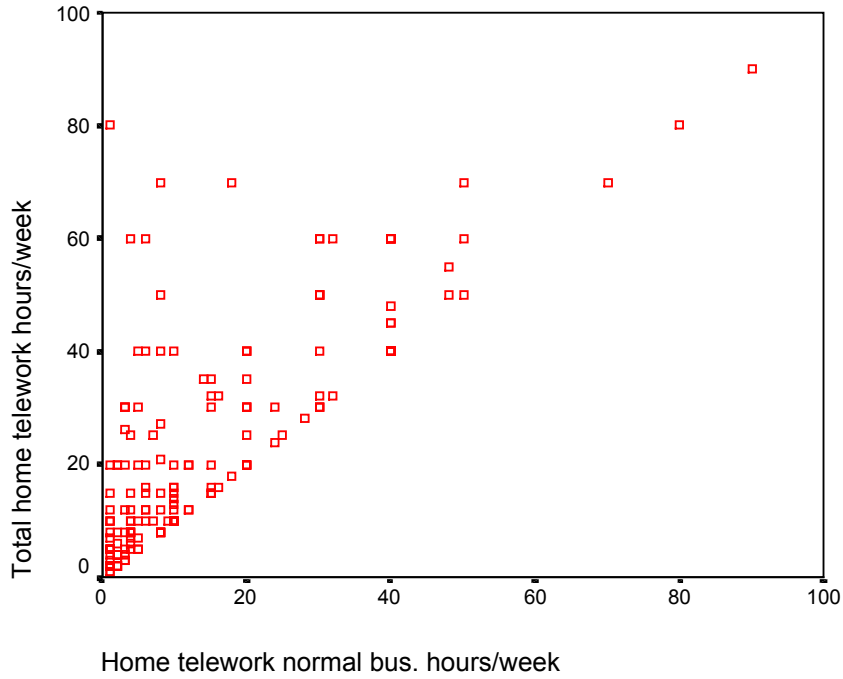
Another key factor is the amount of time teleworkers spend working at home during normal business hours. This is shown in Figure 17. Clearly, there is no central pattern to the work hour distribution.

Figure 17: Distribution of telework hours per week versus days per month



As shown in Figure 18, a large number of teleworkers work at other than normal business hours. Those who telework only during normal business hours fall along the diagonal from the lower left to the upper right corner of the diagram. Those who have telework hours in addition to the normal hours are plotted above that diagonal. It is a little unclear how many businesses have more than 50 “normal” business hours per week, but there seem to be a few.

Figure 18: Home telework total versus normal business hours



Home workspace

One of the important issues in establishing a home workplace is the need for a relatively quiet spot in which to concentrate on work. Still, the other demands of home life often can make this difficult, especially in smaller homes. The general options that the US teleworkers have taken are shown in Figure 19. Figure 20 shows the relative popularity of various locations within—or just outside of—teleworkers' homes.

Figure 19: In what sort of space do you perform job-related work?

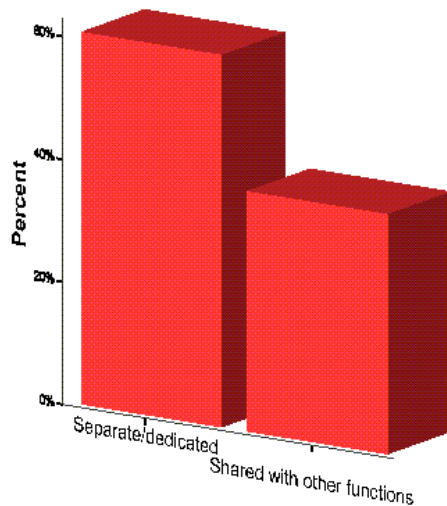
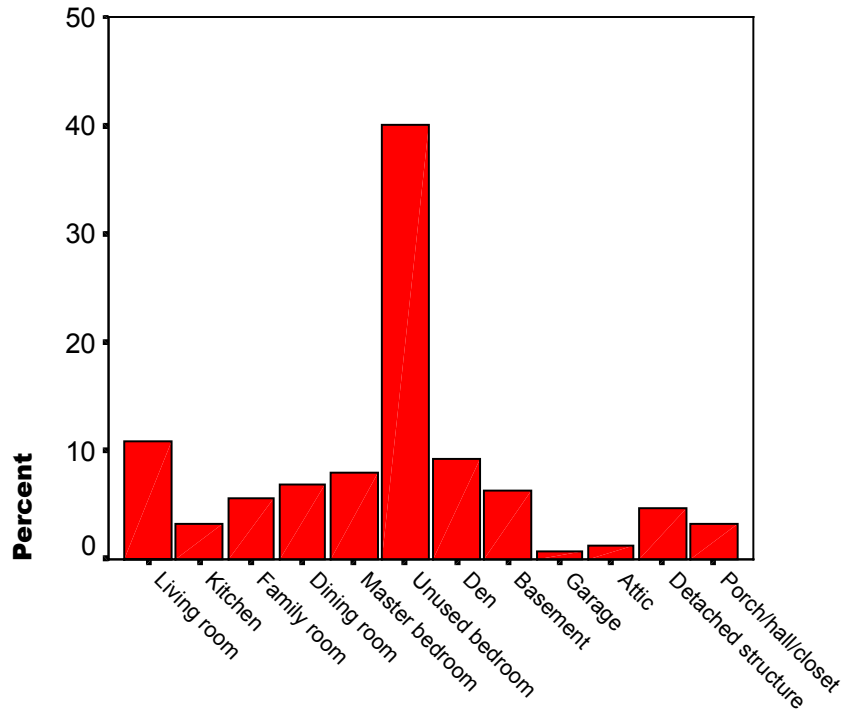


Figure 20: Home office locations



Unused bedrooms are the chief choice by far, with living rooms a distant second, followed by den, master bedroom, dining room and basement. The numbers are given in Table 10.

Table 10: Relative popularity of home office locations

		Frequency	Percent	Valid Percent
Valid	Unused bedroom	100	39.1	40.0
	Living room	27	10.5	10.8
	Den	23	9.0	9.2
	Master bedroom	20	7.8	7.8
	Dining room	17	6.6	6.8
	Basement	16	6.3	6.4
	Family room	14	5.5	5.6
	Detached structure	12	4.7	4.8
	Kitchen	8	3.1	3.2
	Porch/hall/closet	8	3.1	3.2
	Attic	3	1.2	1.2
	Garage	2	.8	.8
	Total	250	97.7	100.0

As a related matter, many employee-teleworkers (82% of them and 69% of contract teleworkers) have retained workspace at their employers' offices. We asked them whether the amount of that space had changed since they began teleworking and, if so, in which direction. 52% of the employee-teleworkers and 42% of the contract-teleworkers reported that there was no change in their employer-office space. 23% of the employee-teleworkers and 7% of the contract-teleworkers reported an increase in office space at their employer's facility. Those who have had decreases in office space at the employer's facility averaged a 36% loss for the employee-teleworkers, as compared to 44% for the contract-teleworkers. However, that total group constitutes only 10% of the home-teleworkers.

17% of employee-teleworkers and 19% of contract teleworkers share workspace at their employer’s facility. For employee-teleworkers there is an even split between sharing the same workstation with others and sharing multiple workstations (that is, hoteling and its variants). For contract-teleworkers the two options are split 2 to 1.

Telework activities

As to the question, “What do these people do when they’re teleworking at home?” Table 11 provides some answers. The categories used in the survey were:

- Computer work such as data entry, writing, graphics, design, online research;
- Telephone calls;
- Reading, planning, or analyzing;
- Face-to-face meetings; and
- Other activities

Table 11: Allocation of activities of home-teleworkers

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Computer work %	249	0	100	55.02	32.97	1087.330
Telephone %	248	0	100	21.69	22.38	500.804
Reading %	248	0	84	11.40	14.31	204.669
Face-to-face meetings %	246	0	100	6.78	14.59	212.950
Other %	243	0	99	6.08	14.94	223.225
Valid N (listwise)	243					

Figures 21 through 25 show these activities in terms of the primary occupations of the teleworkers. As might be expected, and as shown on the table, computer work, telephoning, and reading are the dominant activities of teleworking home-based teleworkers. Computer work is the dominant activity by far.

Figure 21: Percent of computer work while teleworking by primary occupation

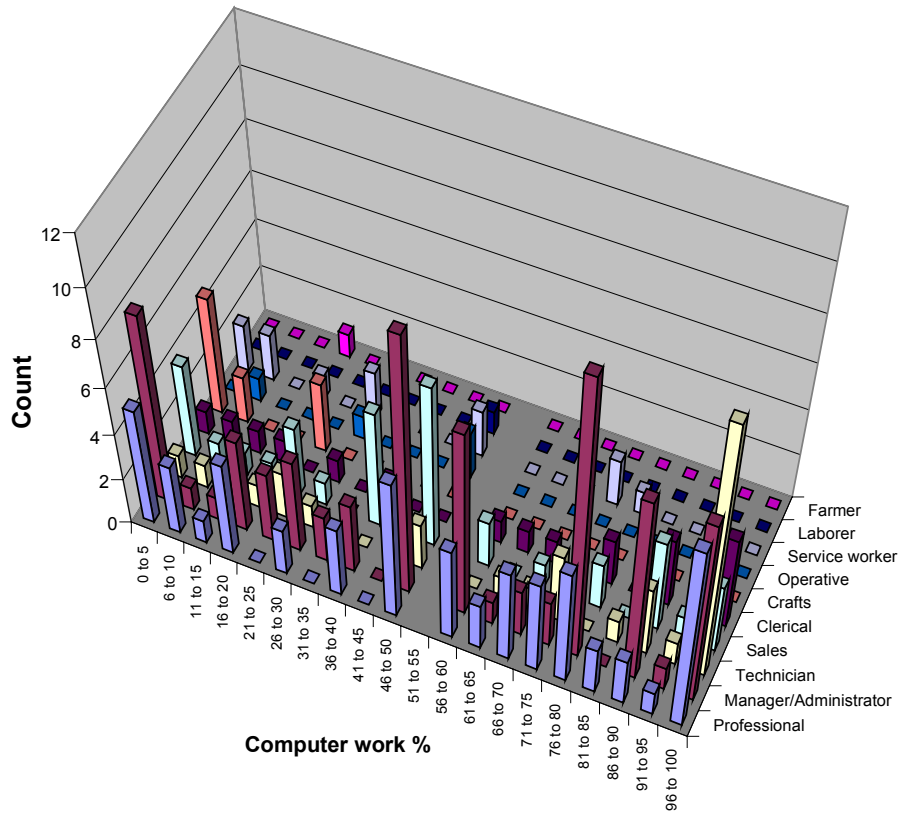


Figure 22: Percent of telephone usage while teleworking by primary occupation

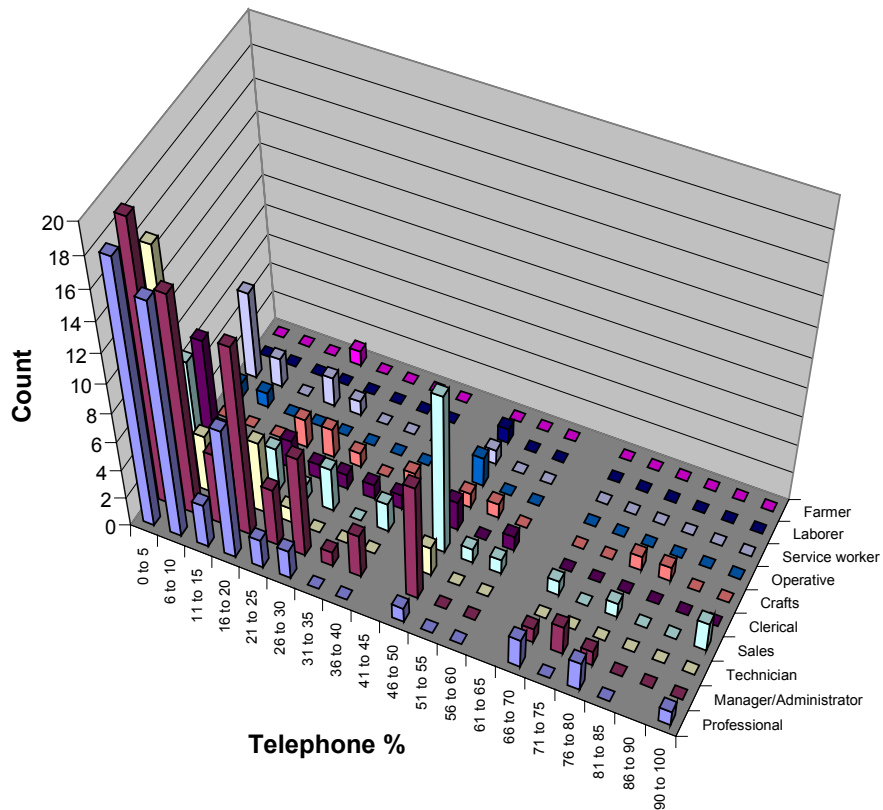


Figure 23: Reading while teleworking by primary occupation

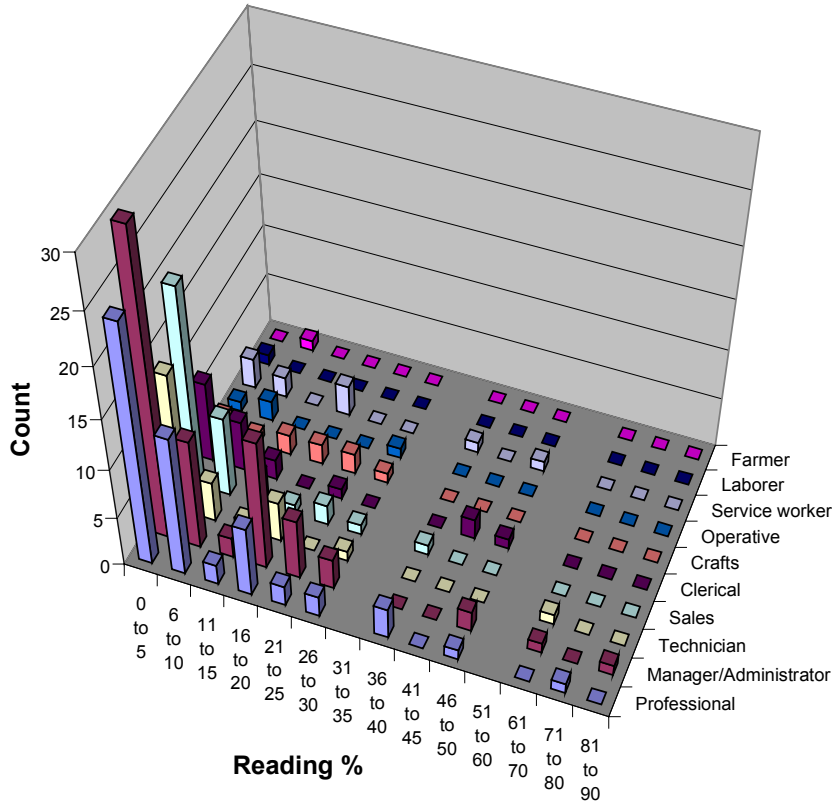


Figure 24: Face-to-face meetings while teleworking by primary occupation

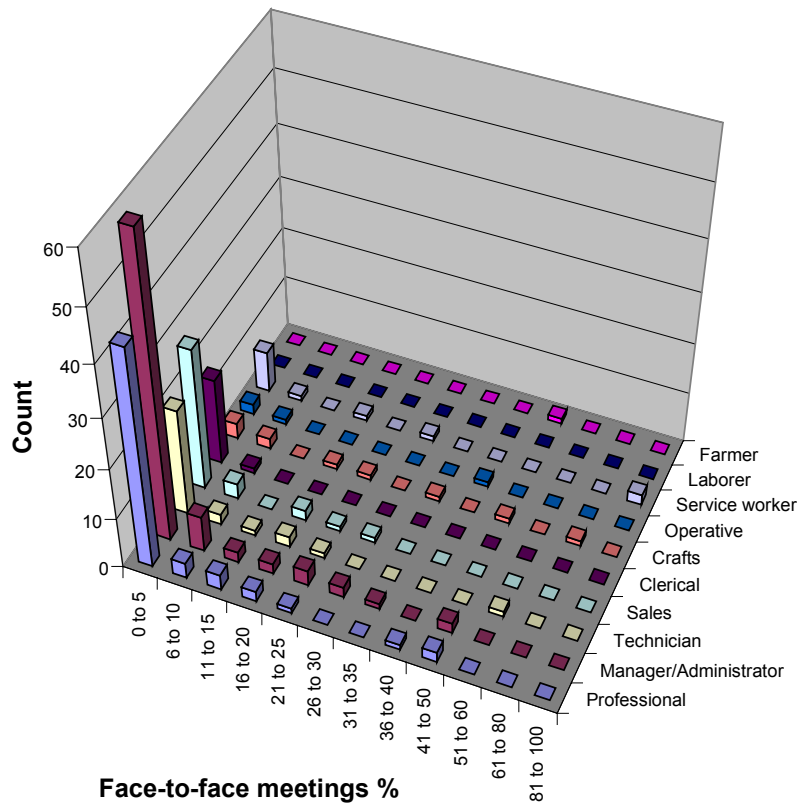


Figure 25: Other activities while teleworking by principal occupation

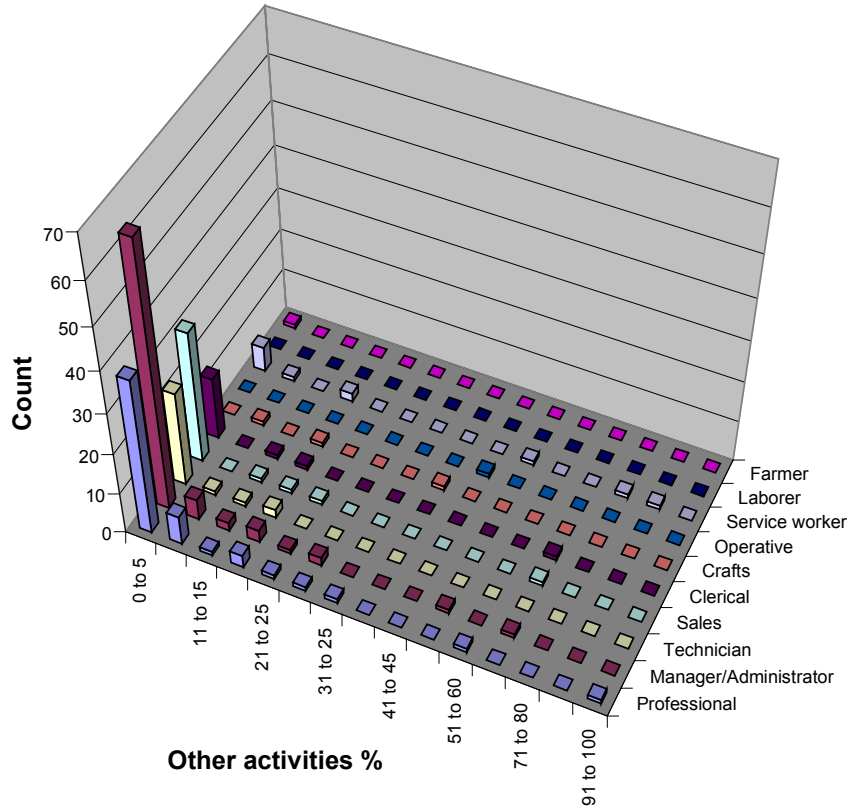
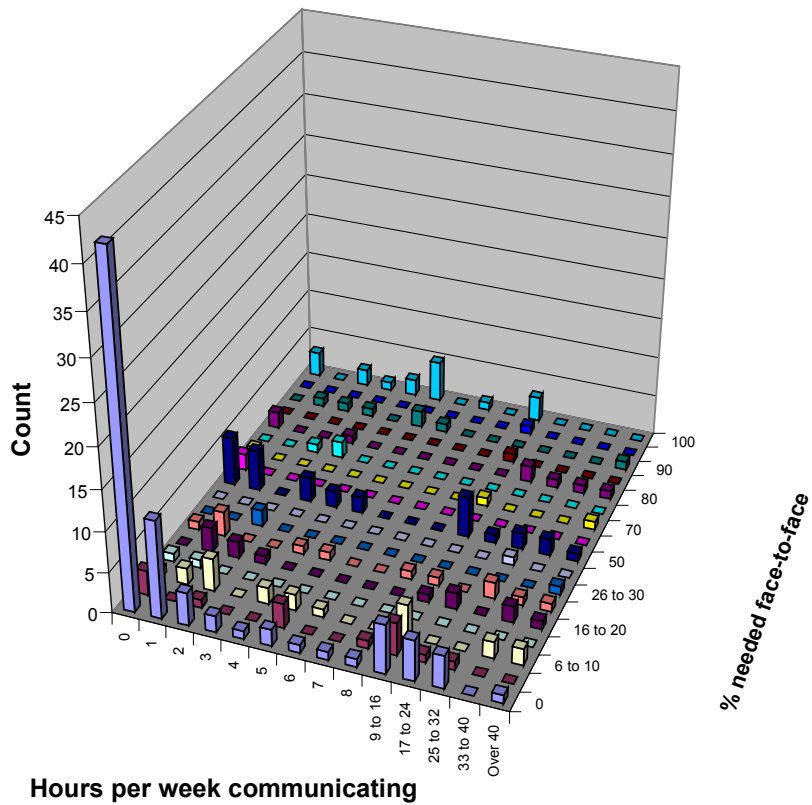


Figure 26: Hours of weekly communication by the need for face-to-face interaction

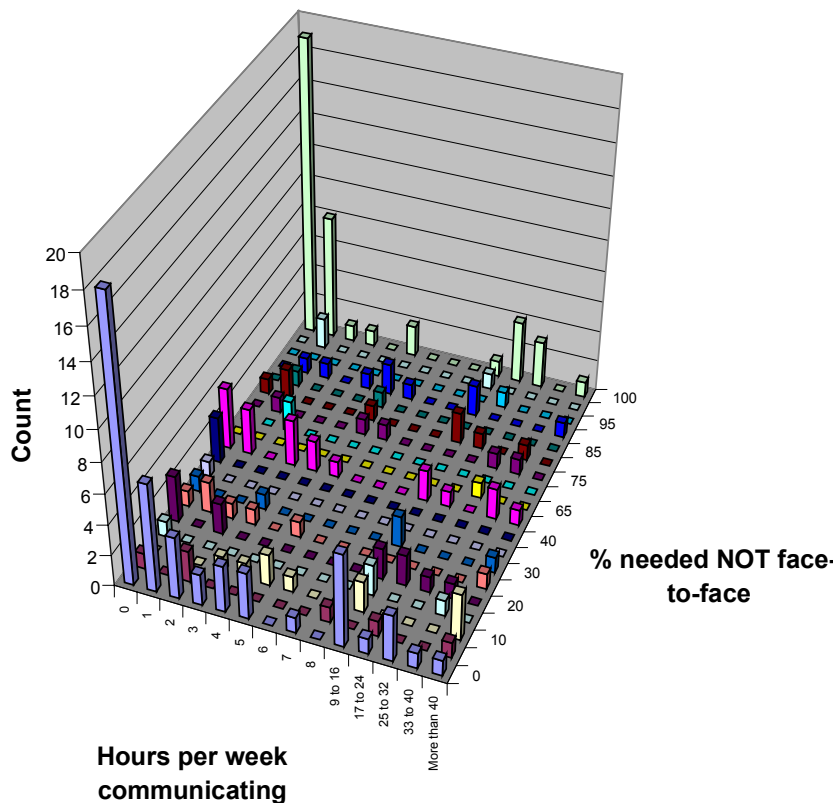


Teleworking versus being there

An important issue in deciding how much teleworking is suitable for a teleworker is the need for face-to-face communication. Until videoconferencing becomes ubiquitous—and probably even after that point—most teleworkers will need to have a certain amount of face-to-face communication with their colleagues. Consequently, we asked the teleworkers how much time they spent weekly in face-to-face communication. We also asked them what percent of the time they felt that communications were required to be face-to-face. The result is shown in Figure 26 for both home-based and center-based teleworkers. There is some ambiguity in these results since several respondents who claimed that they had no hours of weekly communication with others still needed it to be face-to-face!

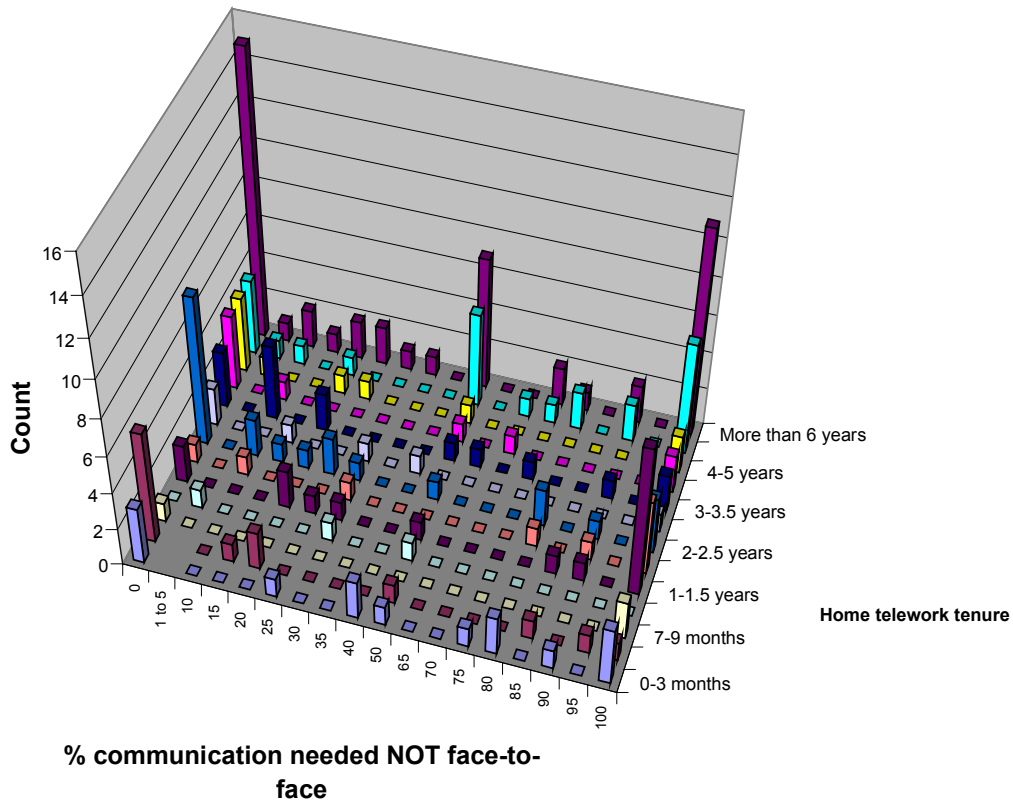
Because some communications needs are better suited to less rich modes we also asked the teleworkers what percent of the time they felt that communications were required *not* to be face-to-face. That result is shown in Figure 27.

Figure 27: The need for *non*-face-to-face communications



Finally, we wanted to see whether the teleworkers' level of experience has an effect on the need/desire for face-to-face communication. Figure 28 shows those results. There does not appear to be a dominant pattern in either of these views, so that the need to communicate face-to-face—or to avoid face-to-face communication—is not strongly dependent on either the amount of communication or the length of experience of the teleworkers. In some of our controlled studies within single organizations there did appear to some interdependences in this regard. They are not confirmed here.

Figure 28: Amount of experience with telework versus felt need for face-to-face communication



As a further test of communication patterns, we asked the teleworkers how much of their communication was local, regional (in-state), national, and international. As expected, most communication was local. The distribution of these options is shown in Table 12. The mean values shown in the table can be confusing. For example, the responses to the home-local communication question tend to fall into a U-shaped distribution, with values clustering near 0 and 100.

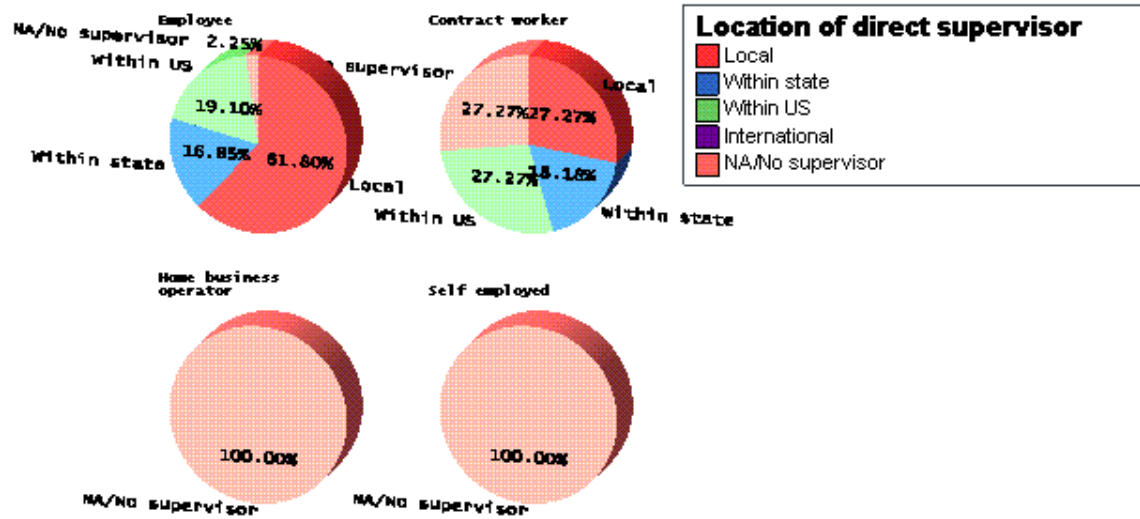
Table 12: Communication distance allocation by teleworkers

		% home-local communication	% home-within-state communication	% home-national communication	% home-international communication
N	Valid	248	247	248	246
	Missing	8	9	8	10
Mean		57.17	20.59	18.79	4.37
Median		70.00	6.00	5.00	.00
Mode		100	0	0	0

Where's the supervisor?

A question likely to be of growing importance, as telework matures and work becomes more global, is where are the supervisors of the teleworkers? The primary impediment to the growth of telework is often said to be managerial resistance, largely based on perceived difficulties in supervision. If this is the case, then we would expect to find that most employee-teleworkers have local supervisors, most home-business- and self-employed-teleworkers have no supervisor other than their customers, and contractor-teleworkers have some arrangement in between. Figure 29 shows the results of the survey.

Figure 29: Location of their supervisor for different types of teleworkers



The options given for direct supervisor location were:

- Local;
- Not local but within the state;
- Not within the state but within the US;
- International; and
- NA/No supervisor.

Somewhat surprisingly, only three of every five employee-teleworkers have local supervisors, with almost one of every five supervised by someone out of state, but within the US. The home business operators and self-employed teleworkers did not have direct supervisors, as expected. Independent contractor-teleworkers' supervisors are about evenly split between local, in-state, in the US, and none. None of the respondents had a direct supervisor who was in another country.

An important question, one that is behind the managerial reluctance issue, is: how can teleworkers' performance be evaluated when their supervisors can't see them? Figure 30 and Table 13 show the primary means of evaluation listed by the teleworkers. Fully one-third of the home employee-teleworkers either had no supervisors or were not evaluated by them. After that group, the most common means of evaluation was by objectives met, followed by the supervisor's acceptance of the word of the teleworker.

Figure 30: Primary methods of evaluating home-only employee-teleworkers

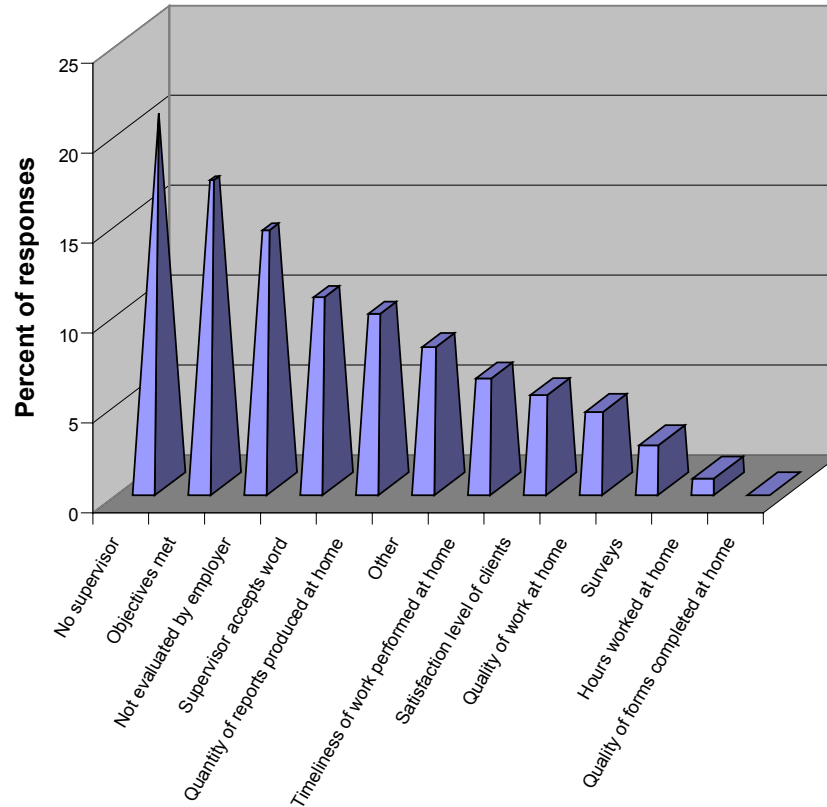


Table 13: Primary method of evaluating teleworkers

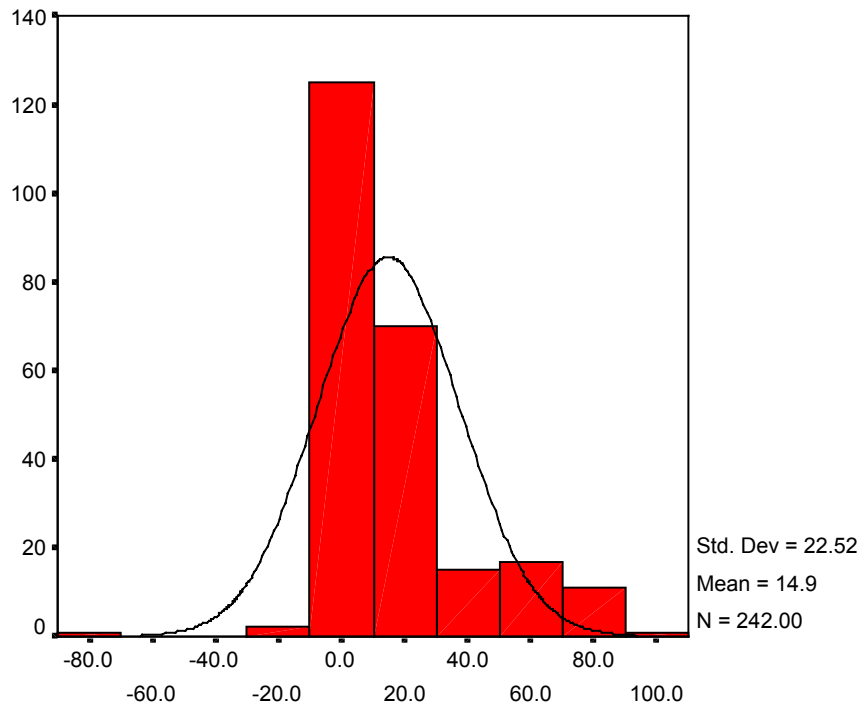
		Frequency	Percent	Valid Percent
Valid	No supervisor	28	17.8	20.6
	Not evaluated by employer	17	10.8	12.5
	Hours worked at home	2	1.3	1.5
	Objectives met	24	15.3	17.6
	Surveys	2	1.3	1.5
	Quality of work at home	7	4.5	5.1
	Quality of forms completed at home	1	.6	.7
	Quantity of reports produced at home	12	7.6	8.8
	Satisfaction level of clients	10	6.4	7.4
	Timeliness of work performed at home	9	5.7	6.6
	Supervisor accepts word	12	7.6	8.8
	Other	12	7.6	8.8
	Total	136	86.6	100.0
Missing	Don't know	21	13.4	
Total		157	100.0	

Productivity impacts

One of the major concerns that prospective telemanagers have is that employee productivity will plummet when they begin teleworking. Consequently, we asked the respondent whether—and, if so, how much and in what direction—their productivity had changed since they began teleworking. Furthermore, we asked them how much

influence teleworking had on the productivity change; this in order to distinguish between telework and other possible causes for productivity changes. The results are shown in Figure 31, with a normal distribution curve superimposed. The values shown are the result of multiplying the total productivity change, if any, by the level of influence of telework (from 0 to 1) on the change.

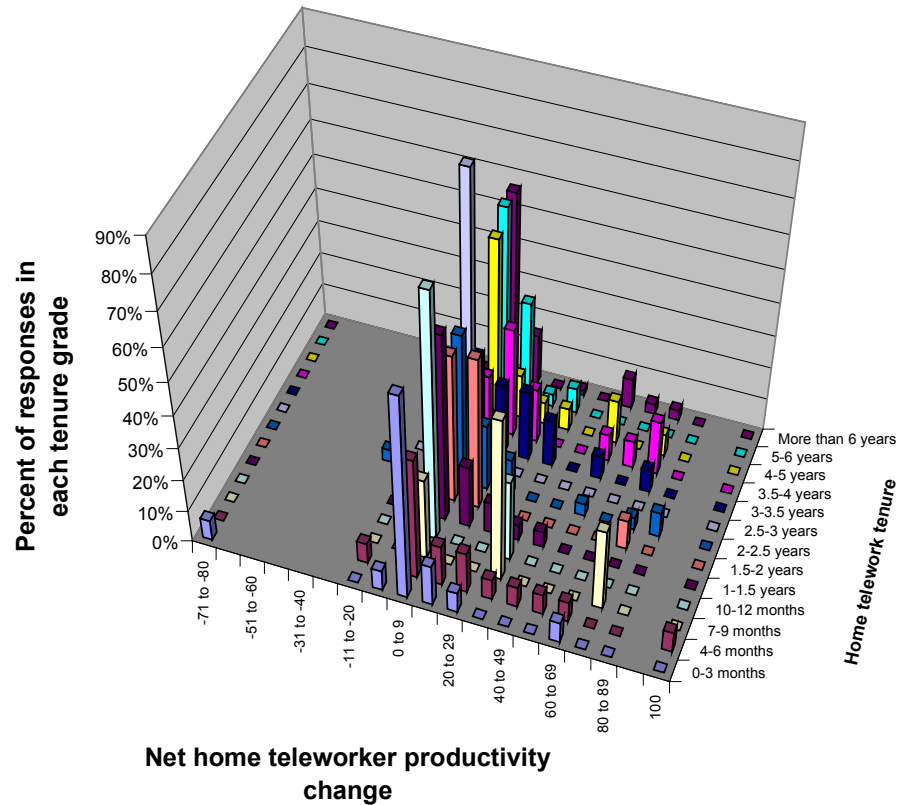
Figure 31: Productivity effect of home-based teleworking.



Clearly, a few teleworkers feel that they have experienced significant losses in productivity, although many more claim equally or higher increases. Figure 32 sheds some light on the situation. The large negative change in productivity is reported by a teleworker with less than four months of experience, possibly with no prior training (although we did not ask about telework-specific training, other than technology-related issues). Similarly, the largest self-reported increase in productivity was reported by someone with less than 6 months of telework experience. One individual, with more than a year's experience with telework, listed telework-induced negative productivity changes of 25%. That individual was self-employed. The rest of the cases where negative effects were reported were from new teleworkers. A productivity reduction is common during the first few months of home-based teleworking as the teleworker adapts to the new situation.

We can establish a dollar impact of this productivity change by multiplying the telework-related change by the respondent's salary. The result of that calculation is that **the average teleworker had a telework-related increase in productivity worth \$9,172 in the past year.** This figure does not include other impacts, such as facility space savings.

Figure 32: Telework productivity effect by teleworking tenure

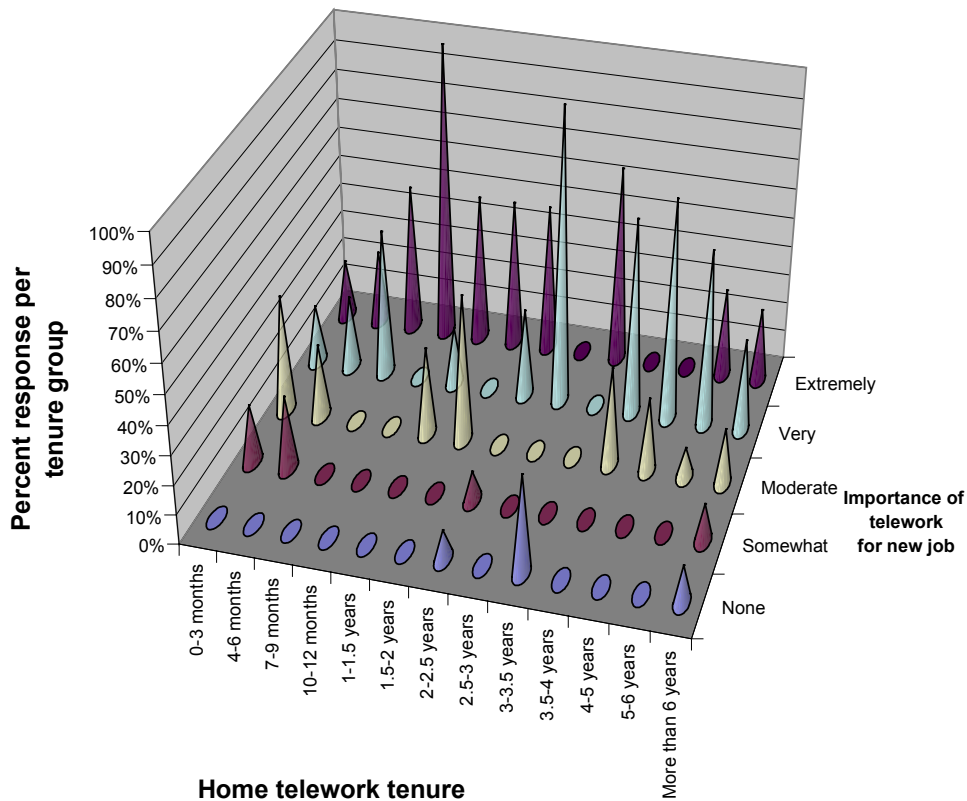


Desire to telework

When the home-based teleworkers were asked whether they would like to alter the frequency of their teleworking, 54% replied that they were satisfied with their current schedules, 38% desired more home teleworking, and 8% wanted to telework less. Of those who wanted to telework less, one-third had less than 10 months'—and another one-third had more than 4 years'—experience at teleworking. There is no apparent relationship between the desire to telework less and the frequency with which the respondents telework.

Telework is reputed to be of growing importance as a means for attracting or retaining skilled workers. We asked the home teleworkers how important the ability to telework would be to them if they were looking for a new job. Figure 33 graphically shows the responses. For the most part, teleworkers indicated that the availability of telework would be very to extremely important if they were to seek a new job. The only area in which this was less the case was for teleworkers with 6 months or less experience.

Figure 33: Importance of telework as a job requirement versus telework experience



Next, we asked the teleworkers whether they had “seriously considered quitting [their] position[s] and taking other job[s] in the past year.” As with the preference question we also asked how much influence the ability to telework had on their decision to stay (that is, to personally do their bit to reduce the labor turnover rate). 42% of the employee-teleworkers responded that they had seriously considered changing jobs. Of that number, 36% said that telework had no effect on their decision; 19% noted some effect; 15% cited a moderate effect; 22% claimed a major effect; and 7% said the ability to telework was decisive in their decision to stay. That is, the ability to telework had an influence on the decision to stay put by 64% of the employee-teleworkers. Figure 34 expresses the responses graphically.

Although estimates vary widely, I think that the cost of replacing a skilled worker is at least equal to the worker’s annual salary. Consequently, we can multiply the salary of a worker who decides not to move by a factor that depends on the influence of teleworking on the decision to stay (the factor is 0 in cases of no influence, and 1 where it was decisive). Of our teleworker survey group, 64 had decided to stay after all. So, the mean impact for their employers was \$19,430. The net benefit to employers for the group as a whole was \$1,244,000. If we spread the impact over the whole group of home-based teleworkers the mean turnover reduction effect of teleworking is \$4,857 per teleworker.

Job satisfaction is related to these answers. Although the great majority of home-teleworkers replied that their job satisfaction was unchanged or improved, a few noted decreased job satisfaction since they began teleworking. The distribution of responses, plotted against length of telework experience, is shown in Figure 35. Those with lessened job satisfaction are either new or fairly experienced teleworkers. Other

than these few cases, reported job satisfaction tends to be proportional to length of experience teleworking.

Figure 34: The effect of telework on the decision *not* to switch jobs

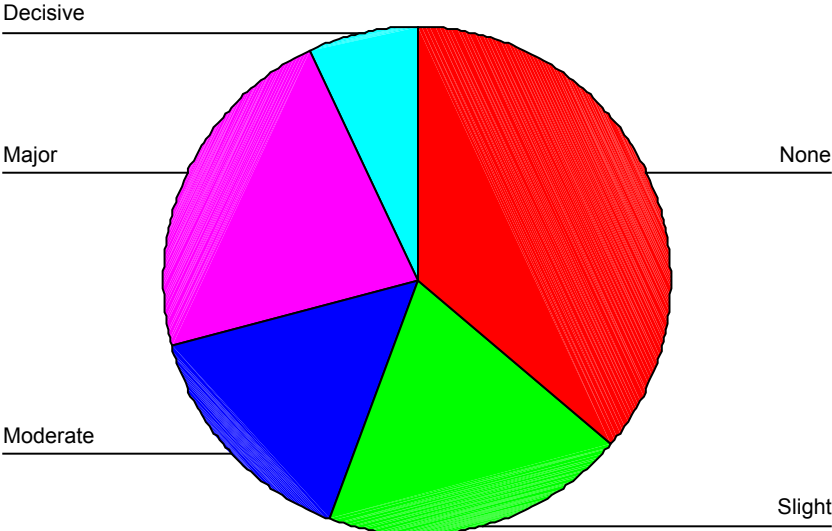
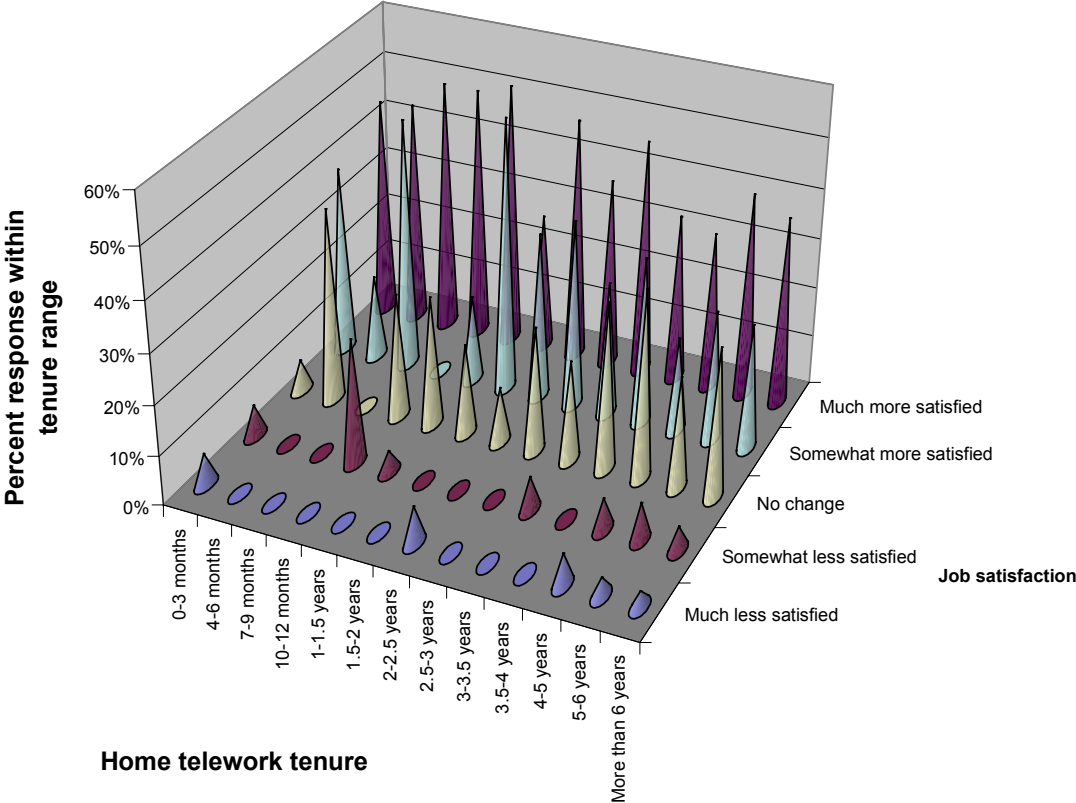


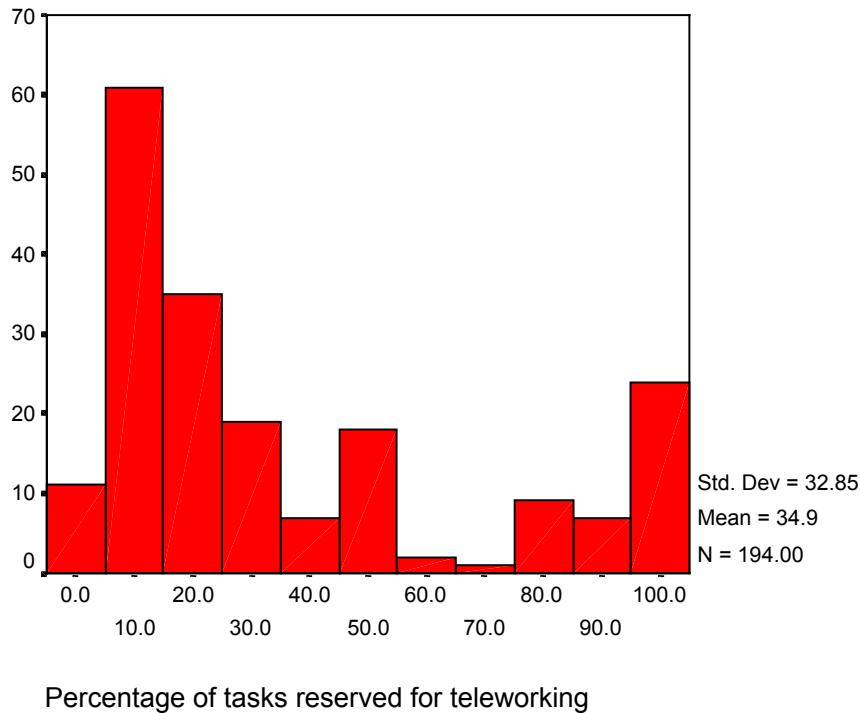
Figure 35: Job satisfaction changes versus length of teleworking experience



Work allocation

One of the presumed characteristics of experienced teleworkers is that they separate their work tasks into two categories: those that can be done (or be done better) while teleworking; and those that are better done in the principal office or other location for face-to-face interaction. Figure 36 shows how the teleworkers surveyed have made this distinction.

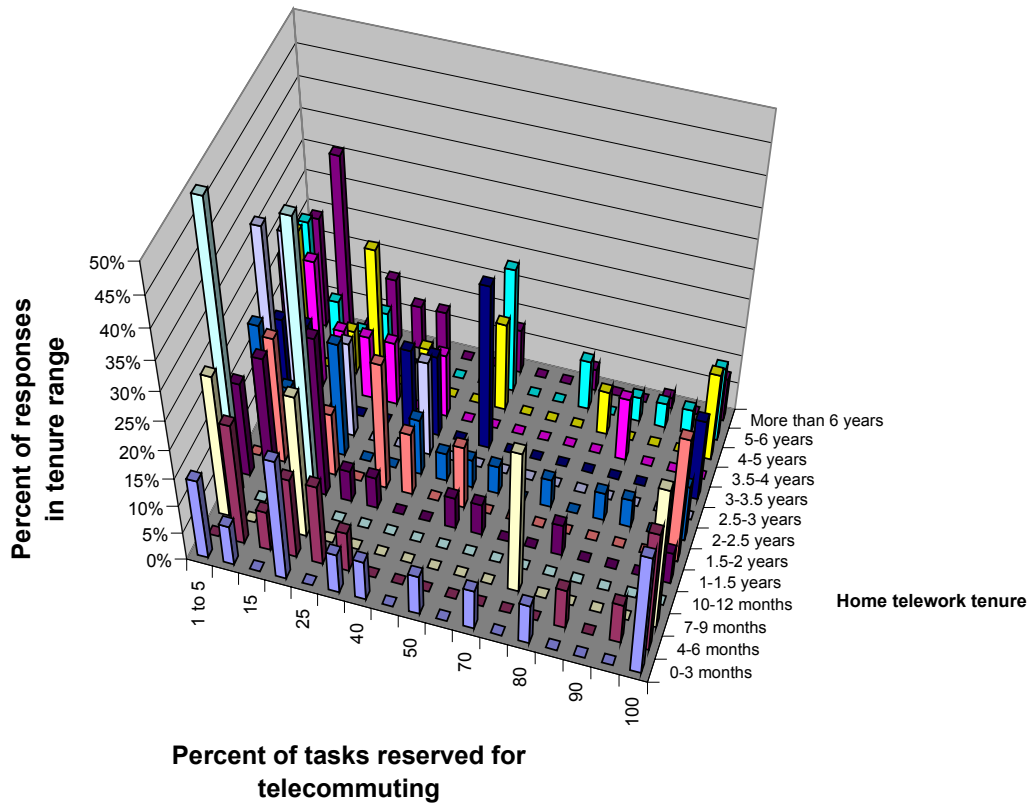
Figure 36: Tasks reserved for teleworking



However, as Figure 37 shows, there is no unequivocal pattern in this selection, at least insofar as length of telework experience goes, although there is a trend toward more reserved tasks with teleworker experience levels. A similar lack of pattern obtains when the percentage of tasks reserved for teleworking is compared with the number of hours per week that the respondents telework. However, there is a correlation (at the 0.01 level) between the percentage of tasks reserved for telecommuting and the days per month worked by the teleworkers during normal business hours. There is a somewhat weaker correlation (at the 0.05 level) between task selection and both hours per week spent communicating and the productivity effect of home teleworking.

Therefore, there is a relationship between the selection of teleworking-specific tasks and the frequency of teleworking, communication levels, and productivity. Also, as a check on the questionnaire logic, there is a positive correlation between the percentage of tasks that home teleworkers spend in face-to-face meetings and the percentage that these need to be face-to-face, with a negative correlation between those face-to-face tasks percentages and the need that they not be face-to-face (both at the 0.01 level). In the coming years it will be interesting to see the extent to which the use of Internet-based videoconferencing will supplant face-to-face interaction.

Figure 37: Telework task allocation versus length of experience



Center-based Telework

As far as we know, no prior survey of teleworkers has included teleworkers who work from telework centers. As noted in the beginning of this chapter (Figure 1), this survey captured the responses of 29 individuals, 19 of whom teleworked only from telework centers. We did not ask the center-based teleworkers as many questions as were posed to the home-based teleworkers since telework centers are in many ways very similar to conventional office environments. The distribution of job types among the center workers, with half of them being employees, is shown in Figure 38.

The general work patterns of the center workers are shown in Figures 39 through 41. Note, however, that there are only 29 center teleworkers; the standard error for that number of respondents is 19%.

Table 14 shows the performance evaluation methods used by the employee-teleworkers surveyed, while Figure 42 shows the productivity changes estimated by the teleworkers since they began working at their centers.

Figure 38: Primary work roles for telework center teleworkers

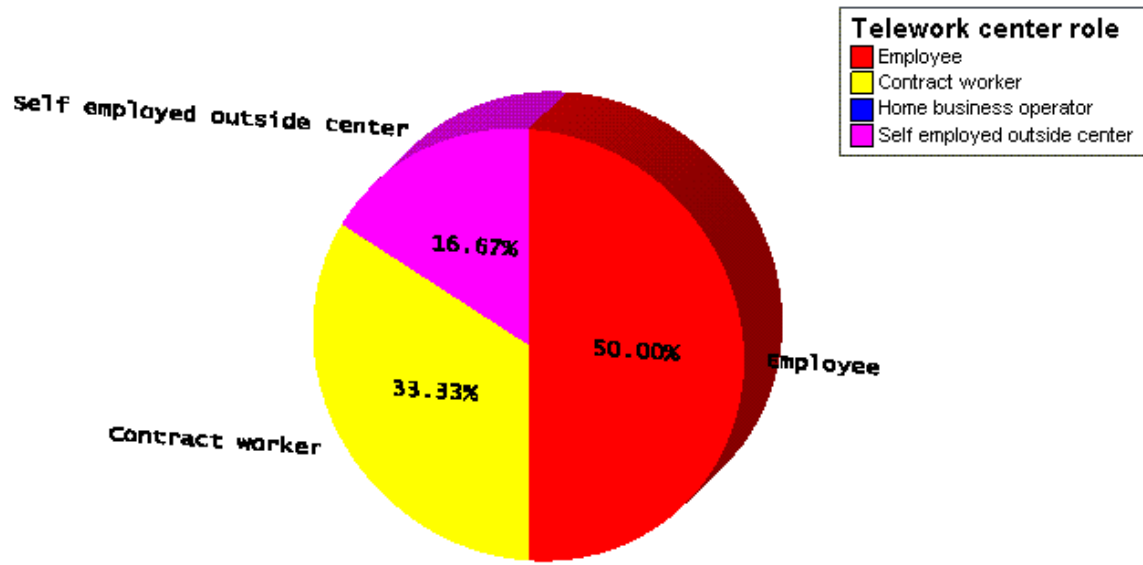


Figure 39: Center telework frequencies

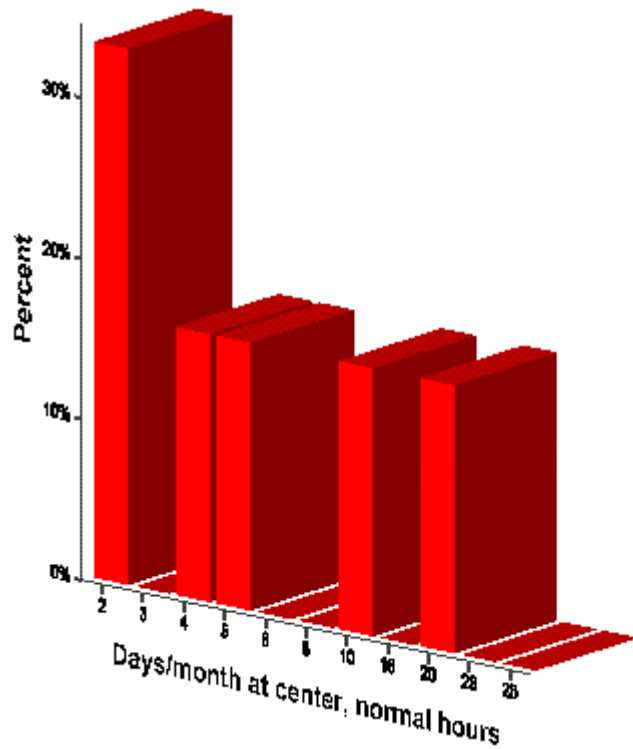


Figure 40: Hours worked per week at a telework center

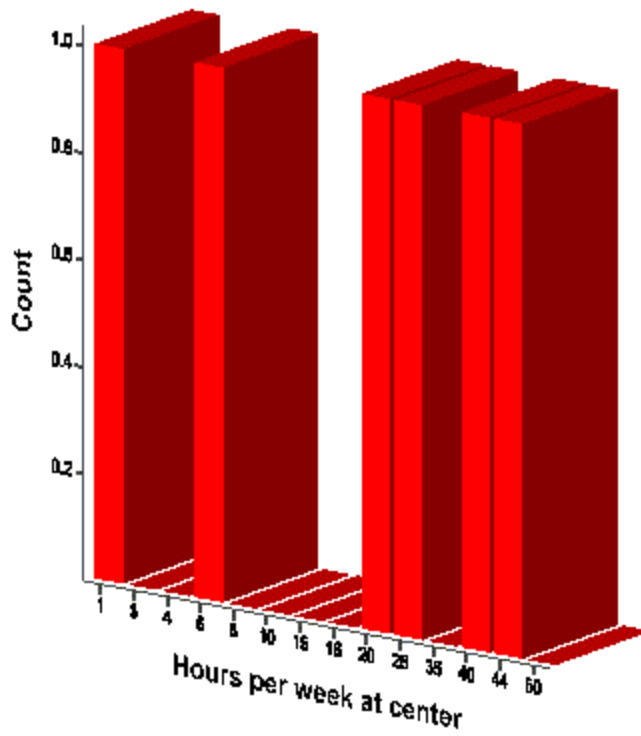


Figure 41: Length of experience at a telework center

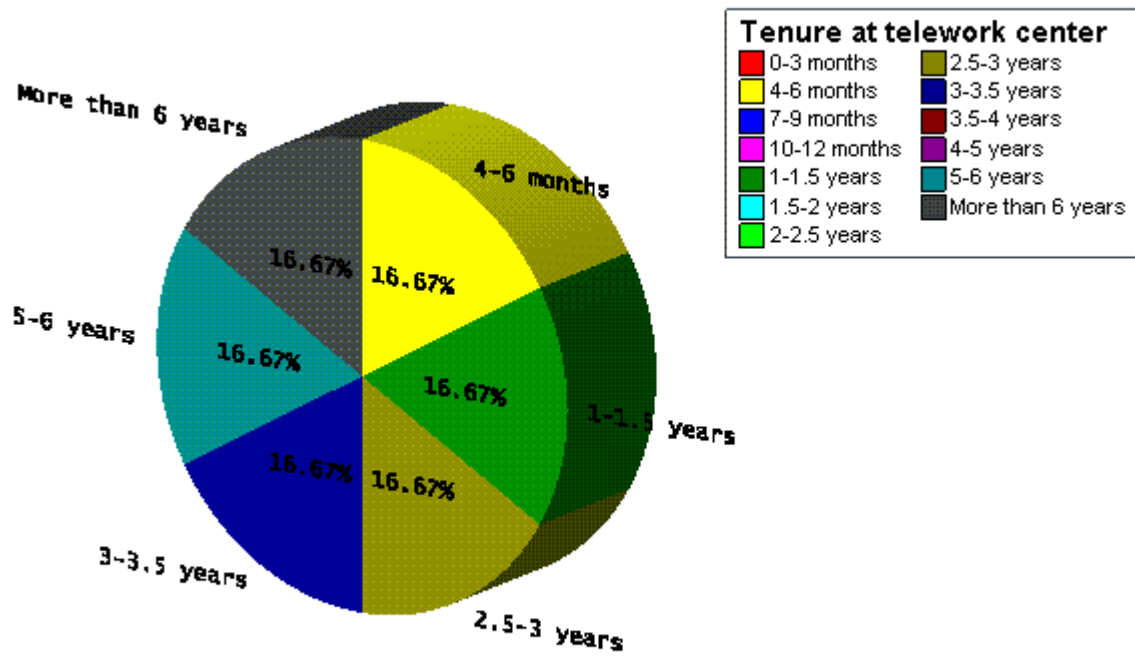
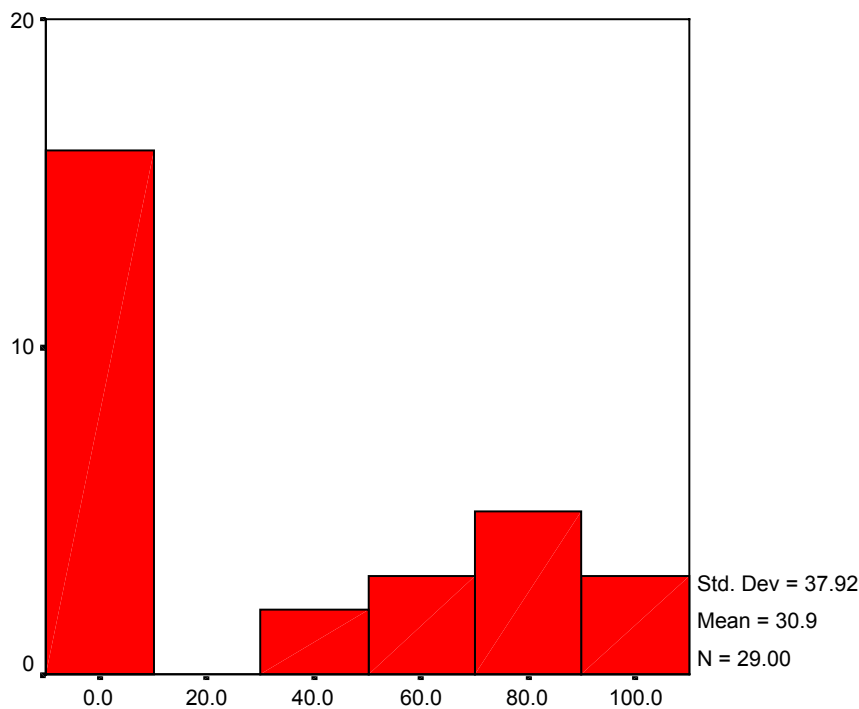


Table 14: Primary criteria for performance evaluation of center teleworkers

		Worker type		Total
		Center-only	Both home and center	
Telework center productivity evaluator	No supervisor	100.0%		100.0%
	Not evaluated by employer	50.0%	50.0%	100.0%
	Objectives met	75.0%	25.0%	100.0%
	Surveys	100.0%		100.0%
	Quality of work performed at center	100.0%		100.0%
	Quality of forms produced	100.0%		100.0%
	Client satisfaction		100.0%	100.0%
	Timeliness of work performed		100.0%	100.0%
	Supervisor accepts work	66.7%	33.3%	100.0%
	Other	50.0%	50.0%	100.0%
Total		65.4%	34.6%	100.0%

Figure 42: Net changes in productivity at telework centers



Finally, we asked the telework center workers whether they would like to work more—or less—at home. The responses are shown in Table 15. It is conceivable that those center-only teleworkers who answered “less” referred to their work at the center rather than home.

Table 15: Center workers’ desire for home telework.

		Worker type		Total
		Center-only	Both home and center	
Center teleworker work at home desire	More	10	9	19
	Less	4	1	5
	No change	5		5
Total		19	10	29

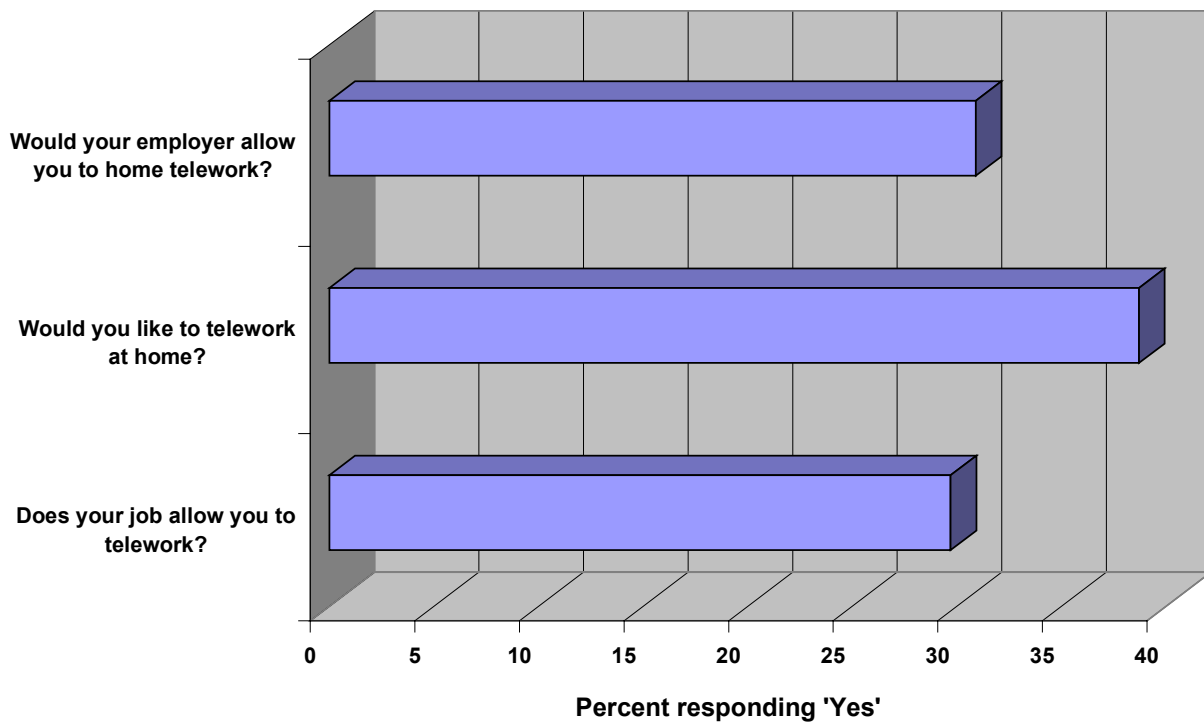
Wannabes

We also asked all those who were not teleworkers whether they would like to do some form of telework. The first question focused on the likelihood that the nature of their jobs would allow teleworking:

- Not counting 'catch-up' work before or after normal business hours, would the nature of your job activities allow you to do any of your work at home on an occasional basis?

This was followed by a question asking whether they would like to work at home, and another asking whether they thought their employer would allow them to work at home. The results of these three questions are shown in Figure 43.

Figure 43: Attitudes of 1596 non-teleworkers toward possible teleworking



Finally, as in the case of the home-based teleworkers, we asked what influence, if any, the potential ability to telework had on those who seriously considered quitting their position and taking another job in the past year. The results are shown in Table 16. Notably, 10% of the non-teleworkers surveyed considered that the ability to telework from home in their new job would have a moderate to decisive influence in their decision to make the move.

Table 16: Influence of possible home telework on job change decisions

		Have considered taking another job		Total
		Yes	No	
Influence of possible home telework on job change decision	None	Count	216	216
		% within Have considered taking another job	48.1%	13.9%
		% of Total	13.9%	13.9%
	Slight	Count	79	79
		% within Have considered taking another job	17.6%	5.1%
		% of Total	5.1%	5.1%
	Moderate	Count	78	78
		% within Have considered taking another job	17.4%	5.0%
		% of Total	5.0%	5.0%
	Major	Count	59	59
		% within Have considered taking another job	13.1%	3.8%
		% of Total	3.8%	3.8%
	Decisive	Count	17	17
		% within Have considered taking another job	3.8%	1.1%
		% of Total	1.1%	1.1%
	Count		1109	1109
	% within Have considered taking another job		100.0%	71.2%
	% of Total		71.2%	71.2%
Total	Count	449	1109	1558
	% within Have considered taking another job	100.0%	100.0%	100.0%
	% of Total	28.8%	71.2%	100.0%

Traffic congestion and urban geography

Commuting patterns

An important, if not the primary, motivation for teleworking, at least on the part of the teleworkers, is to reduce the amount of their commuting to work. To the extent that commuting is reduced by teleworkers there can also be positive side effects, such as reduction in traffic congestion and air pollution—all in proportion to the level of teleworking. Consequently, the commuting questions were a major component of the survey. Table 17 shows the general commuting pattern of our survey population, in answers to the question: “Do you commute to your employer’s worksite at least once every two weeks?”

Table 17: Commuting patterns

		Commutes at least once per two weeks			Total
		Yes	No	Non-employee teleworker	
Worker type Home-only	Count	124	44	76	244
	% within Worker type	50.8%	18.0%	31.1%	100.0%
Center-only	Count	16			16
	% within Worker type	100.0%			100.0%
Both home and center	Count	5	1	4	10
	% within Worker type	50.0%	10.0%	40.0%	100.0%
Non-teleworker	Count	969	176		1145
	% within Worker type	84.6%	15.4%		100.0%
Total	Count	1114	221	80	1415
	% within Worker type	78.7%	15.6%	5.7%	100.0%

The motivation level of teleworkers generally has been considered to be related to the distance they need to travel to work; the greater the commute distance—or time—the greater the motivation. To test that we asked all the respondents about their commuting distances and times. The distributions of numbers of responses to questions about commute distances are shown in Figures 44 through 47 (normal distribution curves are superimposed on each of the graphs).

Figure 44: Distribution of one-way commute distances for home-only teleworkers

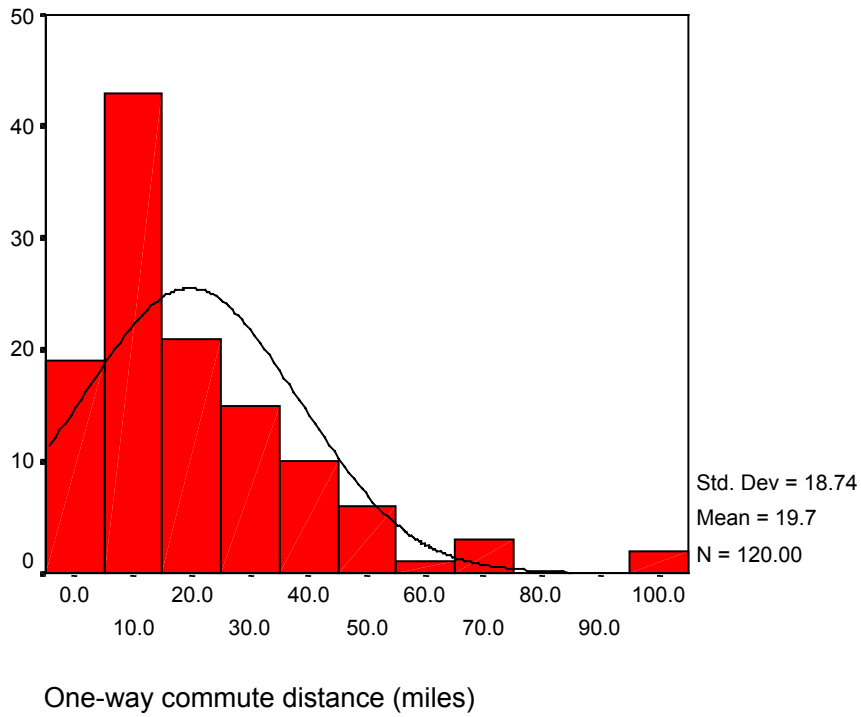


Figure 45: Distribution of one-way commute distances for center-only teleworkers

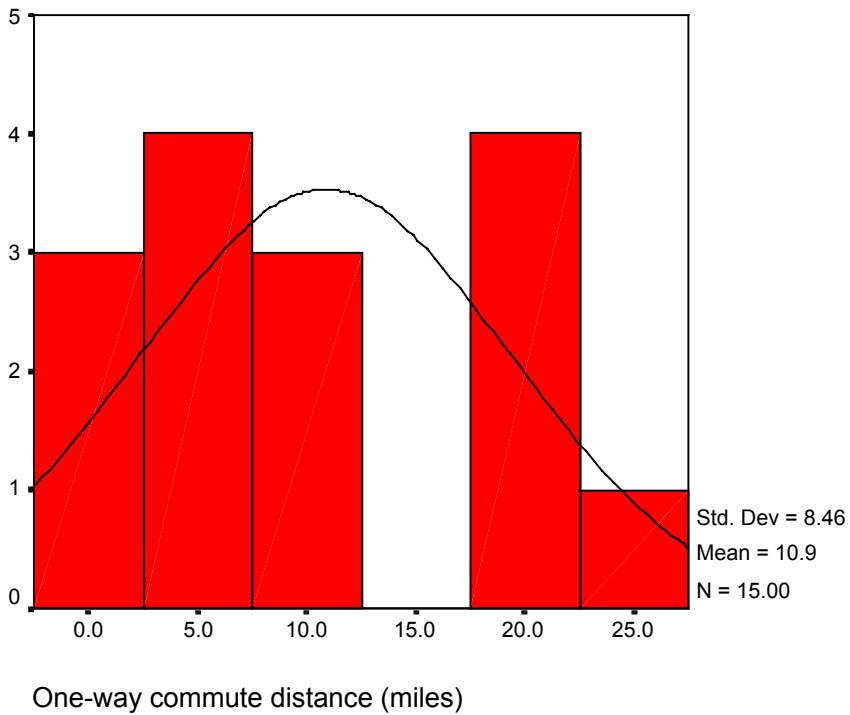


Figure 45 is clearly a non-normal distribution, as is the view in Figure 46 of home- and center-teleworkers. However, since the total number of responses to these two portions is low, major conclusions should not be based on them.

Figure 46: Distribution of one-way commute distances for home- and center-teleworkers

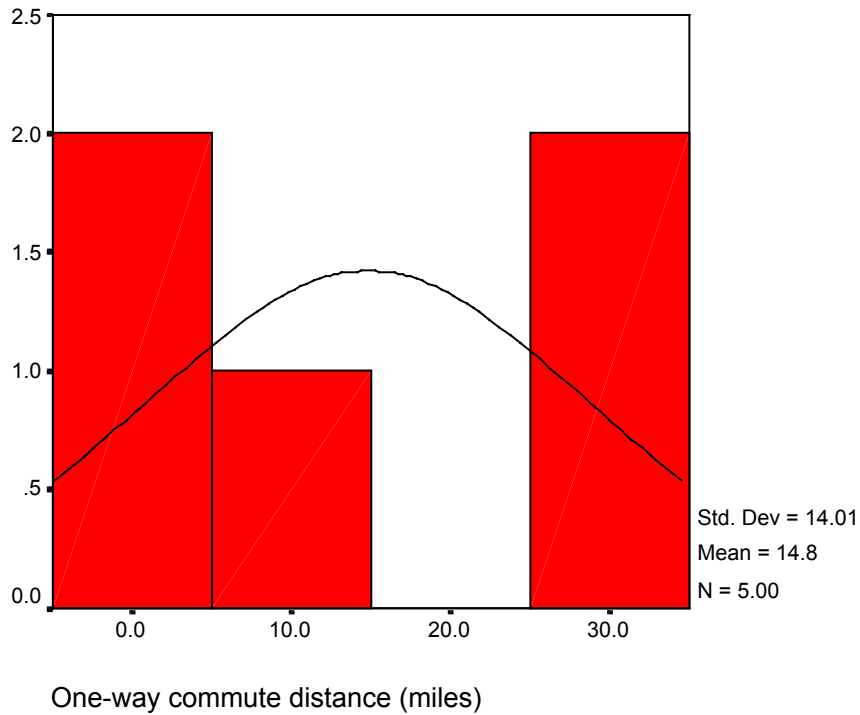
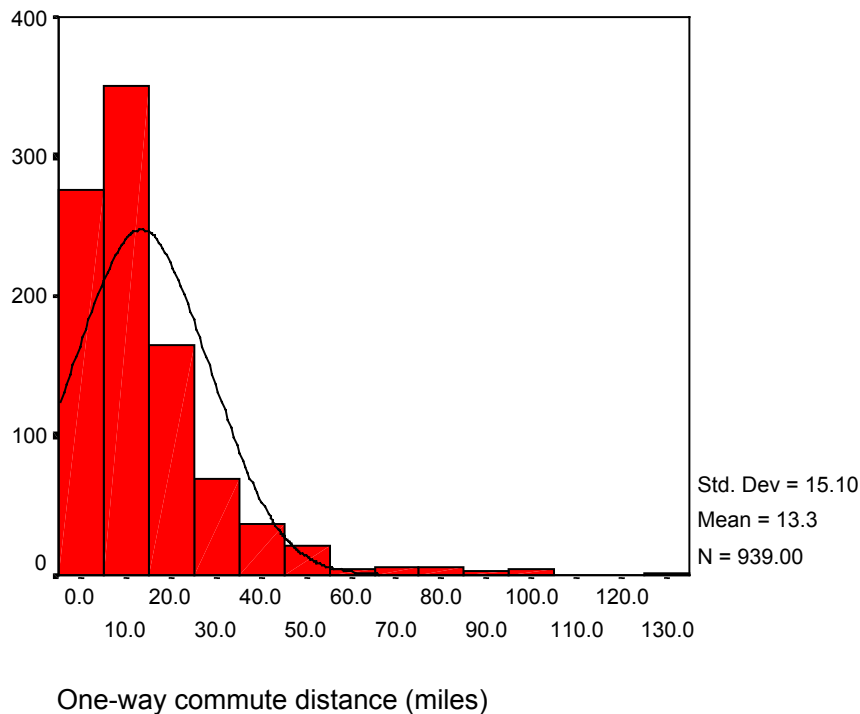


Figure 47: Distribution of one-way commute distances for non-teleworkers



With the exception of the few telework-center-only teleworkers, the assumption that teleworkers commute farther than non-teleworkers is supported. Teleworkers and non-teleworkers take about the same amount of extra distance for errands on commute days, four-and-a-half miles; there is no statistical difference between the

groups in that respect. The differences between the groups in the other primary commute parameters are significant, however, at the 0.05 level or less.

Home teleworker commute times are consistent with their commute distances: 30.2 minutes in the morning and 32.4 minutes in the evening, averaging 39.0mph and 42.5mph, respectively.

Non-teleworkers average morning commute times are 21.7 minutes (33.9mph), while evening commutes take 23.2 minutes (32.5mph).

Teleworkers who work both at home and at a center have commuting characteristics close to those of non-teleworkers, averaging 22.4 minutes (41.3mph) in the morning and 23.4 minutes (37.7mph) in the evening.

Those whose telework is confined to a telework center have the shortest average commute distance, 10.9 miles, but they are slower miles than the others, 32.7mph in the morning and 29.7mph in the evening. The lurid details are in Table 18.

Table 18: Commute parameters by worker type

Worker type		One-way commute distance (miles)	Morning commute minutes	Evening commute minutes	Extra miles for errands on commute days	Morning commute speed (average mph)	Evening commute speed (average mph)
Home-only	Mean	19.67	30.23	32.44	4.37	38.9877	42.5486
	N	120	121	122	105	119	120
	Median	14.00	30.00	27.50	1.00	37.5000	34.6429
Center-only	Mean	10.87	21.13	21.53	7.57	32.6933	29.6508
	N	15	16	15	14	15	14
	Median	8.00	20.00	16.00	4.00	30.0000	31.0000
Both home & center	Mean	14.80	22.40	23.40	4.80	41.2700	37.6700
	N	5	5	5	5	5	5
	Median	9.00	16.00	16.00	5.00	33.7500	30.0000
Non-teleworkers	Mean	13.32	21.71	23.15	4.54	33.9232	32.5184
	N	939	946	938	754	923	916
	Median	10.00	15.00	20.00	2.00	32.0000	30.0000
Total	Mean	14.00	22.66	24.18	4.57	34.5079	33.6457
	N	1079	1088	1080	878	1062	1055
	Median	10.00	16.50	20.00	2.00	33.6750	30.0000

As for the means used to perform that commute, the solo drive to and from work is still the clear winner, even after the hundreds of millions of dollars spent in trying to wean drivers from their cars. "Drive alone" exceeded 82% in all of our worker categories in response to the question: "Which of the following is your primary transportation mode when you commute?" Carpooling came in a distant second, at one-tenth the level overall, followed by public bus or transit (in the case of home-only teleworkers these last two were reversed in their popularity). Van pooling is near the bottom of the list in commuter choices.

The entire set of responses is shown in Table 19.

Table 19: Primary transportation mode for commuting

		Worker type				Total	
		Home-only	Center-only	Both home and center	Non-teleworker		
Primary commute transportation mode	Drive alone	Count	106	14	5	803	928
		% within Worker type	85.5%	87.5%	100.0%	82.9%	83.3%
	Car pool	Count	4	1		86	91
		% within Worker type	3.2%	6.3%		8.9%	8.2%
	Van pool	Count				5	5
		% within Worker type				.5%	.4%
	Public bus or public transit	Count	5			33	38
		% within Worker type	4.0%			3.4%	3.4%
	Private bus or shuttle	Count	1			5	6
		% within Worker type	.8%			.5%	.5%
	Train	Count	1			2	3
		% within Worker type	.8%			.2%	.3%
	Bicycle	Count	3	1		12	16
		% within Worker type	2.4%	6.3%		1.2%	1.4%
	Walk	Count	1			19	20
		% within Worker type	.8%			2.0%	1.8%
	Other	Count	1			1	2
		% within Worker type	.8%			.1%	.2%
	Jog	Count				1	1
		% within Worker type				.1%	.1%
Motorcycle	Count				1	1	
	% within Worker type				.1%	.1%	
Taxi	Count	1				1	
	% within Worker type	.8%				.1%	
School bus	Count				1	1	
	% within Worker type				.1%	.1%	
Air	Count	1				1	
	% within Worker type	.8%				.1%	
Total	Count	124	16	5	969	1114	
	% within Worker type	100.0%	100.0%	100.0%	100.0%	100.0%	

Air quality impacts

One of the important side effects of telecommuting is that it reduces the number of commute trips to and from work. That, in turn, reduces air pollution by keeping the potential pollutants safely locked up in the telecommuters' gas tanks—or at least releasing them at slower rates.

Vehicle-produced air pollution is usually characterized by four components:

- Reactive organic gases (ROG)
- Nitrogen Oxides (NO_x)
- Particulate matter (PM) and
- Carbon Dioxide (CO₂)

Both ROG and NO_x emission estimates have two components: one batch of emissions that occurs during engine warm-up, regardless of the distance traveled; and the second set that consists of emissions during travel. Particulate and CO₂ emissions are primarily distance-related. To estimate the impacts of telecommuting on all this I made the assumption that most car-driving telecommuters owned cars that had the desired gas mileage of 24.05 miles per gallon. Further, I assumed that the emissions were characteristic of cars and light trucks, rather than heavier vehicles. If all telecommuters turn out to be SUV drivers, then the following estimates are undoubtedly too low.

Table 20 shows the average annual amount of air pollution (in grams) not emitted by telecommuters as a consequence of their staying at home and not using their cars while telecommuting.

Table 20: Mean and per-telecommuter limit values of annual air pollutant savings from telecommuting

	N	Minimum	Maximum	Mean
Telework induced reduction of reactive organic gases (gm/telecommuter-yr)	106	159.12	11505.60	2414.2347
Telework induced reduction of nitrogen oxides (gm/telecommuter-yr)	106	122.64	16164.00	3283.1366
Telework induced reduction of particulates (gm/telecommuter-yr)	106	21.60	6480.00	1298.1396
Telework induced reduction of CO ₂ (gm/telecommuter-yr)	106	17850.41	5355123.49	1072792.8997

In this survey we did not ask the respondents whether or not they abstained from using their cars while they were teleworking but results from earlier projects lead me to believe that most of them either do not use their cars or, if they do use them, simply replace trips that otherwise would be made by others in the family. Hence, telecommuting really does produce air pollution reductions (air quality improvements) that are directly proportional to the number of telecommuting days taken and the commute distances foregone.

Teleworker relocation decisions

One of the most persistent potential negative impacts of home-based telework is its ability to allow the teleworkers to move much farther from their employer's location than they would if they were forced to commute there every workday. The scenario is similar to what is known as the freeway effect: as the new highway penetrates exurban rural areas new housing developments spring up. The houses, with their lower-than-urban prices, attract prospective homeowners who are priced out of the urban residential real estate market. The freeway allows them to commute to their employers even though the commute distance is increased (as is air pollution, the need for new roads, schools, power, water, and sanitation infrastructure, etc.). As this development continues, traffic congestion, commute times, energy consumption, and air pollution soar.

Telework adds another dimension to this scenario by possibly allowing people to move even farther out from the job-producing urbs. One possibility of this is continued, or even accelerated, urban sprawl. Another possibility touches a different contemporary dilemma: the death of rural communities. Young people leave small rural communities in order to find jobs in the big city. Most do not return, so the remaining, aging rural population dwindles and the towns die. Yet, many urban dwellers, tired of the noise and pollution would like to move to more rural

communities—if only there were jobs and otherwise suitable environments. So telework also offers the option of leapfrogging, rather than sprawling.

Which of these is more likely to happen? There is no firm evidence that telework plays a significant part in increasing urban sprawl, as follows.

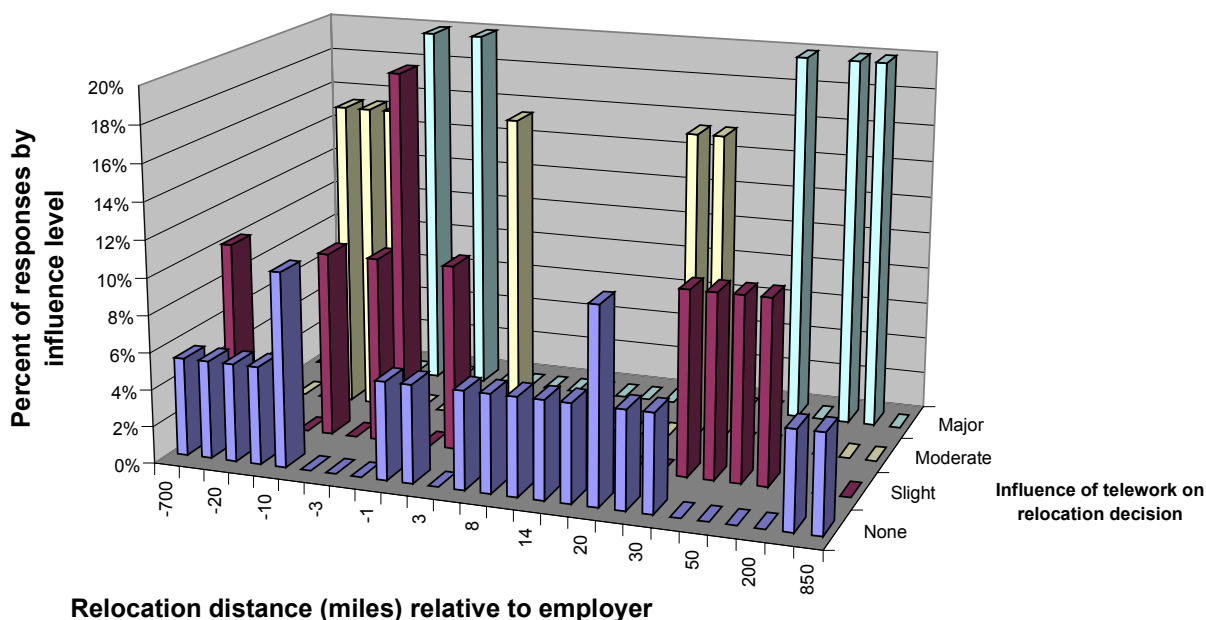
24% of the home teleworkers in our survey have either relocated (13%) or were considering relocating their homes when the survey was made. Table 21 shows the relationship of telework to those decisions or considerations. Figure 48 displays the results in terms of the distance moved (or under consideration) by the employee-teleworkers. Note that *negative* distance values are moves *closer* to the employer’s facility; positive distances are moves away from the facility.

Table 21: The effect of telework on household relocation decisions

% within Relocation status

		Influence of teleworking on relocation			
		None	Slight	Moderate	Major
Relocation status	Have relocated	51.5%	18.2%	21.2%	9.1%
	Haven't, but am considering relocation	53.6%	17.9%	17.9%	10.7%

Figure 48: Influence of telework on household relocation distance for those who either have relocated or were considering it



We also asked those who had relocated, or were considering it, whether their move was to a different sort of community. The results of that question are shown in Table 22.

Table 22: Telework, community type, and relocation decisions

Residence setting change				Influence of telecommuting on relocation				Total
				None	Slight	Moderate	Major	
More rural	Relocation status	Have relocated	Count	1	3	2	2	8
			% within Relocation status	12.5%	37.5%	25.0%	25.0%	100.0%
			% within Influence of telecommuting on relocation	50.0%	60.0%	40.0%	100.0%	57.1%
		Haven't, but am considering relocation	Count	1	2	3		6
			% within Relocation status	16.7%	33.3%	50.0%		100.0%
			% within Influence of telecommuting on relocation	50.0%	40.0%	60.0%		42.9%
	Total		Count	2	5	5	2	14
			% within Relocation status	14.3%	35.7%	35.7%	14.3%	100.0%
			% within Influence of telecommuting on relocation	100.0%	100.0%	100.0%	100.0%	100.0%
More urban	Relocation status	Have relocated	Count	6		1		7
			% within Relocation status	85.7%		14.3%		100.0%
			% within Influence of telecommuting on relocation	100.0%		100.0%		63.6%
		Haven't, but am considering relocation	Count		2		2	4
			% within Relocation status		50.0%		50.0%	100.0%
			% within Influence of telecommuting on relocation		100.0%		100.0%	36.4%
	Total		Count	6	2	1	2	11
			% within Relocation status	54.5%	18.2%	9.1%	18.2%	100.0%
			% within Influence of telecommuting on relocation	100.0%	100.0%	100.0%	100.0%	100.0%
About the same	Relocation status	Have relocated	Count	10	3	3	1	17
			% within Relocation status	58.8%	17.6%	17.6%	5.9%	100.0%
			% within Influence of telecommuting on relocation	52.6%	75.0%	60.0%	50.0%	56.7%
		Haven't, but am considering relocation	Count	9	1	2	1	13
			% within Relocation status	69.2%	7.7%	15.4%	7.7%	100.0%
			% within Influence of telecommuting on relocation	47.4%	25.0%	40.0%	50.0%	43.3%
	Total		Count	19	4	5	2	30
			% within Relocation status	63.3%	13.3%	16.7%	6.7%	100.0%
			% within Influence of telecommuting on relocation	100.0%	100.0%	100.0%	100.0%	100.0%

But, to get better insight as to whether the ability to telework has an urban-sprawl-inducing effect we focused on the teleworkers who had actually moved and for whom the ability to telework had a moderate or major influence (no one reported it as having a decisive influence). The results are in Table 23. The median relocation distance was 30 miles farther from the employer's location.

All but one of the 5 moves were to more rural settings. Only one of the moves was to a more rural location that likely increased the commute distance (a health services worker who teleworks less than 8 hours weekly). The largest long distance move was by a full time teleworker in sales; the move was from an urban setting to a town (just the sort of thing rural community revivifiers are looking for).

Table 23: Household relocation factors for those in which telework had a moderate or major influence

	Residence setting change		Total
	More rural	About the same	
Household	-10	1	1
relocation	3	1	1
distance	30	1	1
	200	1	1
	800	1	1
Total	4	1	5

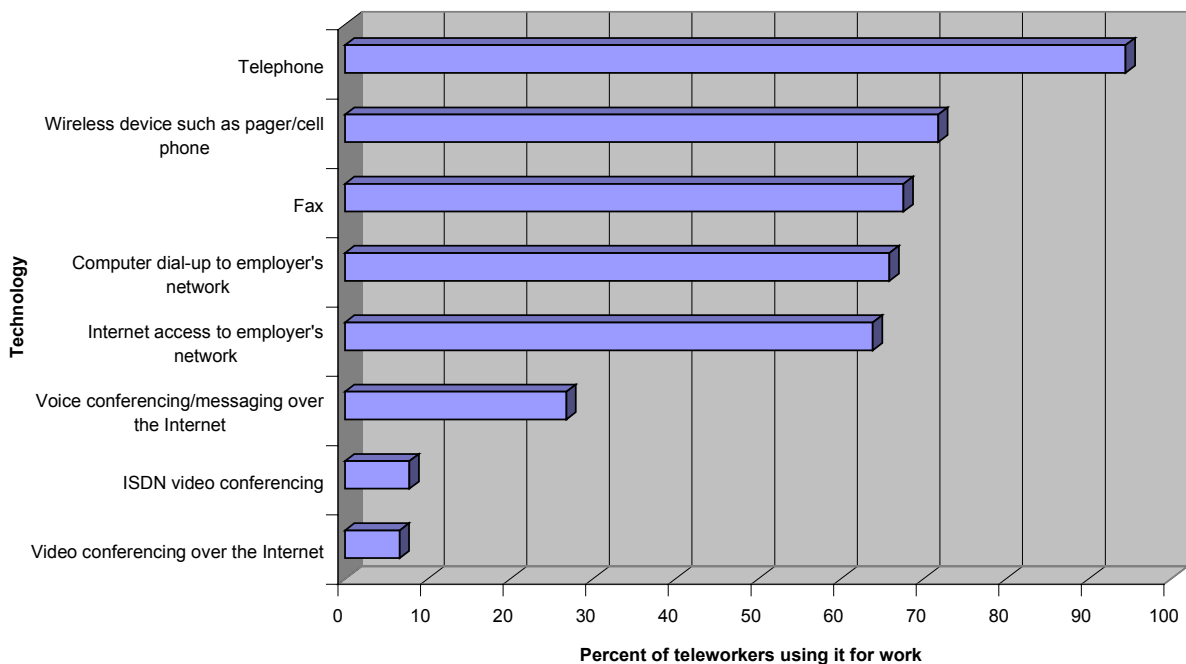
The result of this analysis is that there is no firm evidence that telework plays a significant part in increasing urban sprawl, or at least no more significant an effect than that of aiding in the revitalization of small rural communities.

Technology Impacts

Home-based teleworkers and technology

Arguably the second most popular reason given by employers *not* to adopt telework is that the required technology costs too much relative to the benefits it is likely to produce. Therefore, it is worth examining the technology uses of actual teleworkers. Figure 49 shows the technologies used by the teleworkers we surveyed. The telephone is still king.

Figure 49: Technologies used by teleworkers



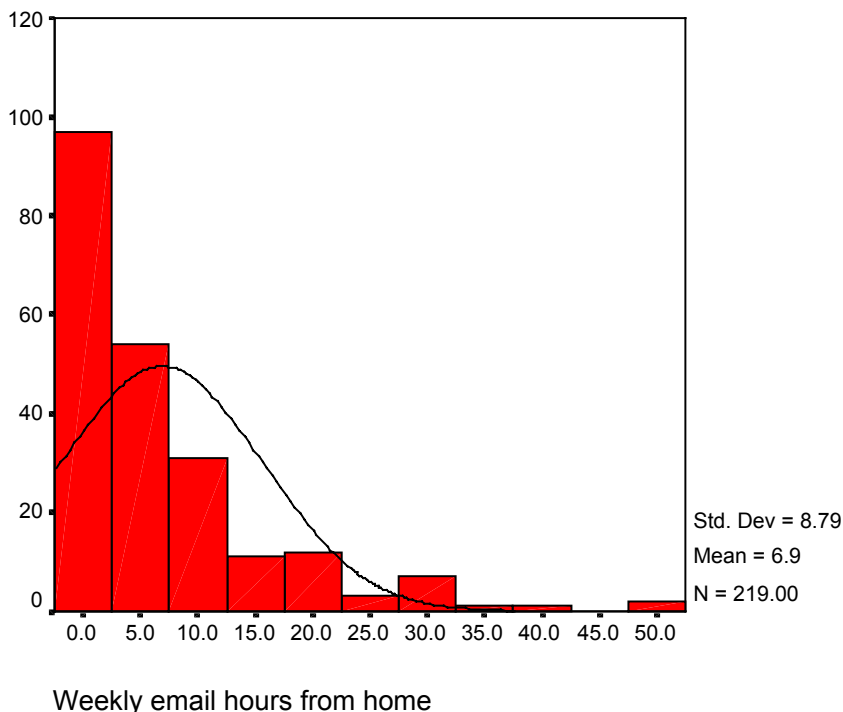
	Video conferencing over the	ISDN video conferencing	Voice conferencing /messaging	Internet access to employer's	Computer dial-up to employer's	Fax	Wireless device such as pager/cell	Telephone
Percent of teleworkers using it for work	6.6	7.8	26.8	63.9	65.9	67.6	71.8	94.5

In the early days of teleworking computer use was not as ubiquitous as it is now. But as the Internet Age blooms, one of the central phenomena of the workplace is the trend toward the use of email for many, if not most, office communications. Figure 50 shows the distribution. Although the median³ is 3 hours, the distribution is skewed by

³ The halfway point in terms of numbers of teleworker responses.

a few heavy email users, making the average almost 7 hours per week spent in reading or sending email.

Figure 50: Hours spent weekly by home teleworkers in reading/sending email



A common question, posed both by prospective teleworkers and their employers, is: who pays for the needed equipment? Table 24 shows the survey results: the employer pays for the capital costs, in one way or another, for slightly more than half the employee-teleworker cases; otherwise the teleworker pays all. 68.8% of contract home teleworkers and 39.1% of employee teleworkers pay all the costs.

Table 24: Who pays for the equipment used for home-based telework?

	Frequency	Percent	Valid Percent	Cumulative Percent
Employer pays for equipment, teleworker pays maintenance	21	8.5	12.8	12.8
Employer pays all	47	19.1	28.7	41.5
Teleworker pays but employer subsidizes	20	8.1	12.2	53.7
Teleworker pays all	76	30.9	46.3	100.0
Total	165	66.7	100.0	
Missing Don't know	82	33.3		
Total	246	100.0		

One of the potential problem areas with telework is that the teleworker with technology problems is likely to be remote from a source of assistance. Although we have found in the past that this issue often serves to increase the level of self-reliance of the teleworkers—or at least those who survive the techno-isolation—it is important to see how much prior training teleworkers have had. Hence, we asked the following question: *On average, how much formal training did you get for the computer-associated technologies you use while working at home?* The responses are shown in Table 25. Clearly, only 19% of home teleworkers get intensive training in the technologies they use.

Table 25: Computer-related training received by home-based teleworkers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	141	55.1	57.1	57.1
	Brief overviews	59	23.0	23.9	81.0
	Intensive, one-day-or-more courses	47	18.4	19.0	100.0
	Total	247	96.5	100.0	
Missing	Don't know	8	3.1		
	Refused	1	.4		
	Total	9	3.5		
Total		256	100.0		

Absent training, what sources of information do teleworkers use to cope with the technological demands of their work? Table 26 tells the story. The local guru edges out the manuals as the most important information source. This is consistent with our experience in several large-scale telework projects.

Table 26: The most important source of technology information

Most important info source

		Frequency	Percent	Valid Percent
Valid	Local guru	52	20.3	21.8
	Manuals	49	19.1	20.5
	Phone hot line	39	15.2	16.3
	Periodicals	37	14.5	15.5
	Information center	17	6.6	7.1
	Unknown	16	6.3	6.7
	Users meetings	15	5.9	6.3
	Online	14	5.5	5.9
	Total	239	93.4	100.0
	Missing	Don't know	14	5.5
Refused		3	1.2	
Total		17	6.6	
Total		256	100.0	

General Technology Use

We asked all of the respondents, teleworker and non-teleworker alike, a series of questions about their uses of technology. The first questions were about the mainstay electronic implements in their homes: personal computers (PCs), televisions (TVs), and videocassette recorders (VCRs). In the case of PCs, we also asked how many were used for work and how many were not used for work. Teleworkers are pretty much like the other workers in their ownership of TVs but have significantly more PCs. The average numbers (and related statistics) are shown in Table 27. The differences in ownership of these devices are statistically significant (at the $p=0.01$ level or less) for all but TV ownership.

One might conclude from this that the average teleworker household has at least two PCs, one for work and one for other uses. However, reality is somewhat different from that, as can be seen in Tables 28 and 29.

Table 27: Average home ownership of PCs, TVs, and VCRs by worker type

Worker type		PCs at home not used for work	PCs at home used for work	TVs at home	VCRs at home
Home-only	Mean	1.00	1.00	2.55	1.88
	N	243	245	245	245
	Std. Deviation	.99	.61	1.36	1.04
Center-only	Mean	1.00	.53	2.68	2.21
	N	19	19	19	19
	Std. Deviation	.58	1.17	1.34	1.55
Both home and center	Mean	1.20	1.00	3.00	1.30
	N	10	10	10	10
	Std. Deviation	1.03	.67	1.05	.82
Non-teleworker	Mean	.75	.22	2.53	1.73
	N	1594	1597	1589	1592
	Std. Deviation	.73	.53	1.33	1.00
Total	Mean	.79	.33	2.54	1.76
	N	1866	1871	1863	1866
	Std. Deviation	.77	.61	1.33	1.01

Table 28: Distribution of PCs not used for work by worker type

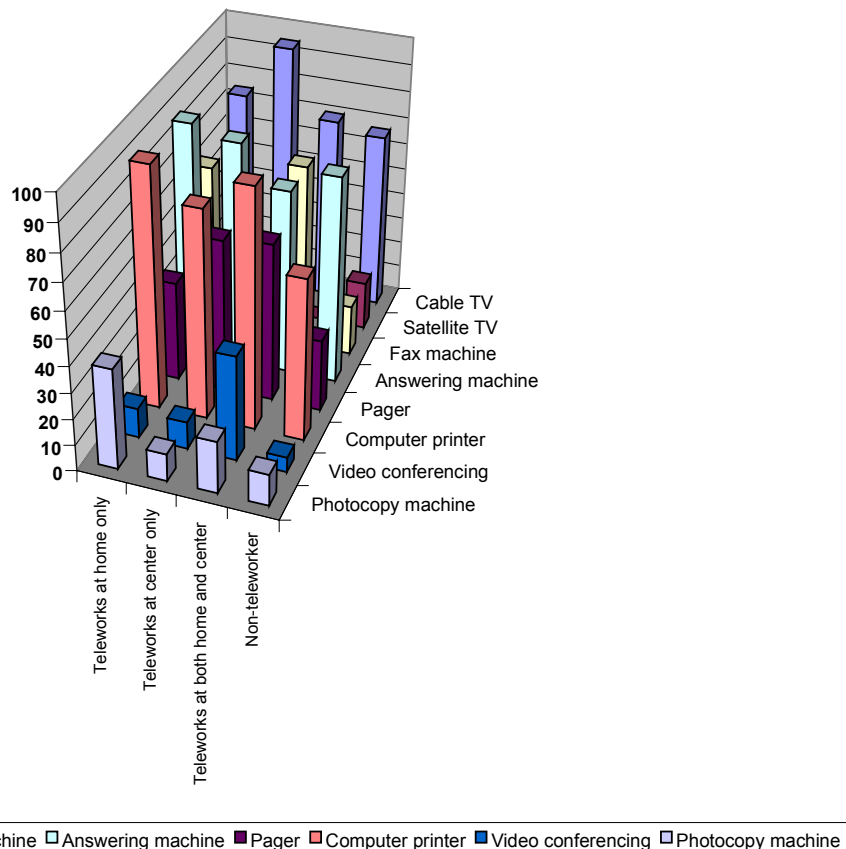
			Worker type				Total
			Home-only	Center-only	Both home and center	Non-teleworker	
PCs at home not used for work	0	Count	78	3	3	594	678
		% within Worker type	32.1%	15.8%	30.0%	37.3%	36.3%
	1	Count	114	13	3	849	979
		% within Worker type	46.9%	68.4%	30.0%	53.3%	52.5%
	2	Count	34	3	3	121	161
		% within Worker type	14.0%	15.8%	30.0%	7.6%	8.6%
	3	Count	12		1	19	32
		% within Worker type	4.9%		10.0%	1.2%	1.7%
	4	Count	3			7	10
		% within Worker type	1.2%			.4%	.5%
	5	Count	1			2	3
		% within Worker type	.4%			.1%	.2%
	6	Count				1	1
		% within Worker type				.1%	.1%
	7	Count	1			1	2
		% within Worker type	.4%			.1%	.1%
Total		Count	243	19	10	1594	1866
		% within Worker type	100.0%	100.0%	100.0%	100.0%	100.0%

Table 29: Distribution of PCs used for work by worker type

			Worker type				Total
			Home-only	Center-only	Both home and center	Non-teleworker	
PCs at home used for work	0	Count	38	13	2	1292	1345
		% within Worker type	15.5%	68.4%	20.0%	80.9%	71.9%
	1	Count	177	5	6	273	461
		% within Worker type	72.2%	26.3%	60.0%	17.1%	24.6%
	2	Count	24		2	19	45
		% within Worker type	9.8%		20.0%	1.2%	2.4%
	3	Count	5			9	14
		% within Worker type	2.0%			.6%	.7%
	4	Count	1			3	4
		% within Worker type	.4%			.2%	.2%
	5	Count		1			1
		% within Worker type		5.3%			.1%
	7	Count				1	1
		% within Worker type				.1%	.1%
Total		Count	245	19	10	1597	1871
		% within Worker type	100.0%	100.0%	100.0%	100.0%	100.0%

We also asked all the respondents about other technologies or technology-based services they had or used at home. Those results are shown in Figure 51.

Figure 51: Percent ownership/use of other technologies at home



Here, too, the teleworkers are more technology-intensive than non-teleworkers, except for center-only teleworkers with photocopier machines and all center teleworkers with satellite TV. The numerical details are shown in Table 30.

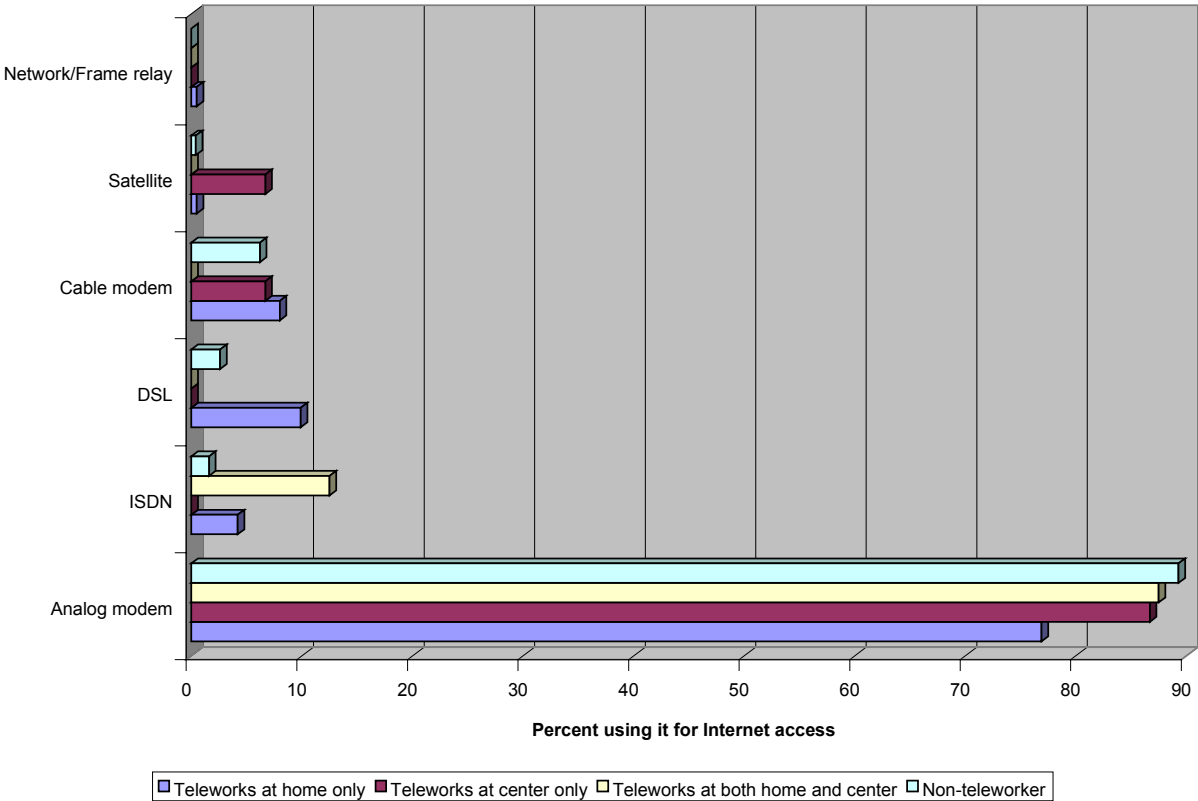
Table 30: Percent ownership/use of other technologies at home by worker type

Worker type	Cable TV	Satellite TV	Fax machine	Answering machine	Pager	Computer printer	Video conferencing	Photocopy machine
Teleworks at home only	74.3	20.0	63.3	88.2	38.0	91.0	11.4	38.4
Teleworks at center only	94.7	15.8	15.8	84.2	57.9	78.9	10.5	10.5
Teleworks at both home and center	70.0	0.0	70.0	70.0	60.0	90.0	40.0	20.0
Non-teleworker	67.0	18.3	19.2	78.4	27.4	61.3	5.7	12.1

Internet access from home is also an area in which teleworkers have higher participation rates than non-teleworkers, averaging 88.4% to 56.5%, respectively. Still, essentially three of every five US workers have Internet access.

Given the extensive press coverage about the impending wideband boom in the Internet, we also asked how the Internet users gained access to the 'Net from home. The dominant access technology for four fifths of the respondents is still the analog modem connected to a phone line (19% of them slower than 56.6 kbps), as can be seen in Figure 52. As in the other cases, the teleworkers are more likely to have wideband Internet access.

Figure 52: Technology used for Internet access from home.



As to time spent dealing with email, Figures 53 through 56 tell the story; home teleworkers win the prize for email hours spent weekly, averaging around 7 hours, compared with four-and-a-half for everyone else.

Figure 53: Hours spent weekly by home-only teleworkers reading/sending email

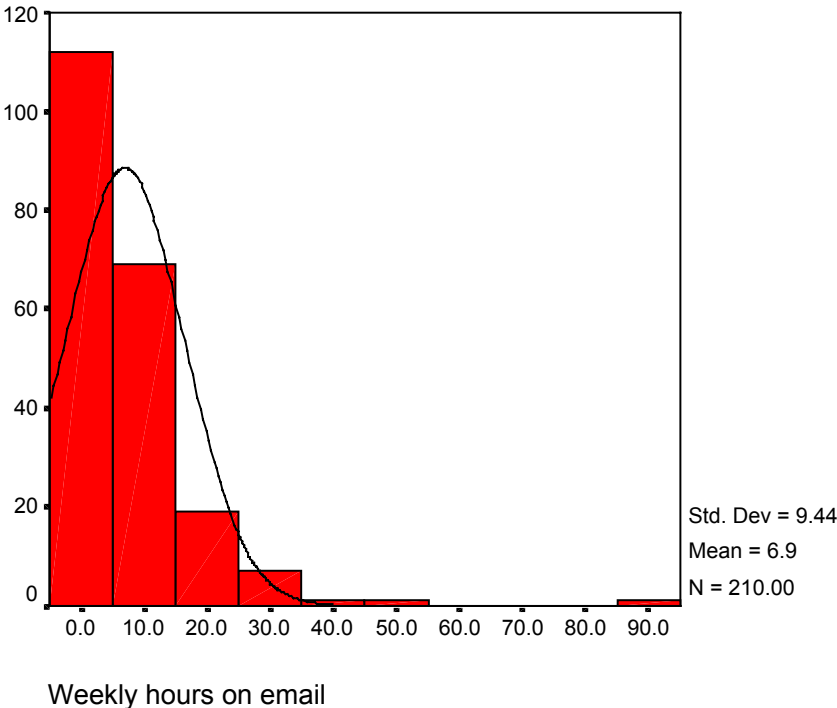


Figure 54: Hours spent weekly by center-only teleworkers reading/sending email

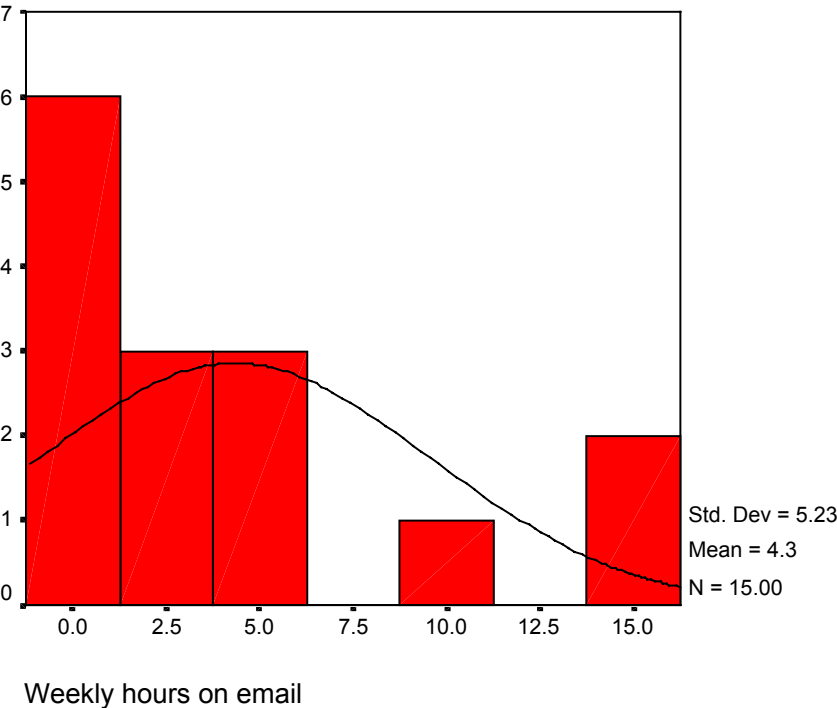


Figure 55: Hours spent weekly by home-and-center- teleworkers reading/sending email

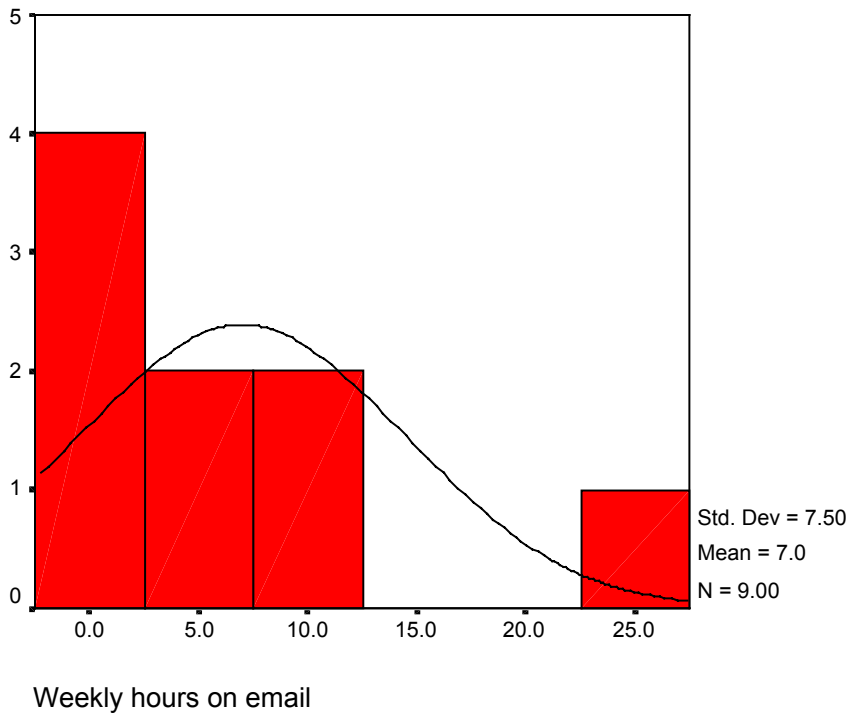
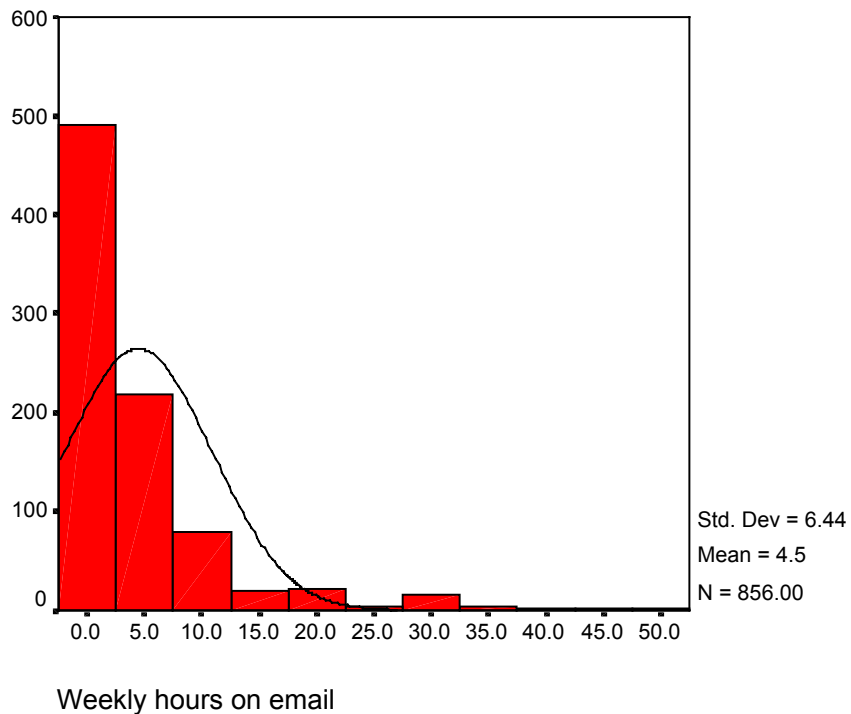


Figure 56: Hours spent weekly by non-teleworkers reading/sending email



Finally, we had a few seconds left per interview, so we asked about usage of the Internet for shopping. 19.3 percent of all interviewees stated that they had used the Internet for shopping in the past 30 days. For those who had not I-shopped during that period, the primary reasons for abstention were as shown in Table 31.

Table 31: Primary reasons given for not shopping on the Internet

		Frequency	Percent	Valid Percent
Valid	No need	302	38.9	44.9
	Privacy concerns	83	10.7	12.4
	Can't feel the goods	64	8.2	9.5
	No access	50	6.4	7.4
	No time/too busy	48	6.2	7.1
	Access costs too much	30	3.9	4.5
	Not in the last 30 days	27	3.5	4.0
	Equipment/service hard to understand	20	2.6	3.0
	Fraud concerns	18	2.3	2.7
	Don't use the Internet	14	1.8	2.1
	Don't have a credit card	14	1.8	2.1
	Use the Internet at work/other places	2	.3	.3
	Total	672	86.5	100.0
	Missing	Don't know	98	12.6
Refused		7	.9	
Total		105	13.5	
Total		777	100.0	

Almost half of those who responded claimed that they had no need to shop on the Internet. The next most common answer, from one-eighth of the respondents, was their concern about maintaining their privacy. There was little difference in responses among teleworkers and non-teleworkers.

Some European Comparisons

The US has long been considered the leader in the adoption of telework. But telework is by no means confined to the US. The Europeans, in particular, have made significant gains in the adoption of telework in the past few years. The European Commission (EC) funded a number of telework related research and demonstration projects, amounting to several million dollars, throughout the 1990s.

In 1994 and 1999 the EC supported surveys similar to this one, covering the EU member countries in 1994 and all of Western Europe in 1999. There are some definitional differences. In the EU surveys, the respondents were split into an age category and three nonexclusive telework types:

- Employed workers, 16 years old or older (our definition put the lower limit at 18 years)
- Home-based telework (at least one full day per week; tighter than our definition)
- Self employed in SOHO (Small Office/Home Office; includes self-employed and, possibly, contractors), and
- Mobile telework (including both telework center telework and telework at other office locations, such as client offices, at least 10 hours per week; this may include forms of telework that were not covered in our survey).

The source for the European data in this chapter is a January 2000 report by empirica Gesellschaft für Kommunikations- und Technologieforschung mbH titled *Benchmarking Telework in Europe 1999*.

Table 32: European Union teleworkers in 1999⁴

Teleworkers in EU countries in 1999					
	Home-based telework	Self-employed in SOHO	Mobile telework	Any kind of regular telework	As % of workforce
Denmark	121,000	37,000	56,000	176,000	6.6
Finland	142,000	47,000	55,000	229,000	10.8
France	272,000	45,000	182,000	499,000	2.3
Germany	538,000	536,000	520,000	1,562,000	4.4
Ireland	14,000	8,000	4,000	26,000	1.9
Italy	315,000	90,000	270,000	584,000	2.9
Netherlands	285,000	166,000	308,000	593,000	8.3
Spain	162,000	32,000	65,000	259,000	2.0
Sweden	207,000	61,000	90,000	313,000	8.0
UK	630,000	234,000	550,000	1,273,000	4.8
EU 10	2,687,000	1,257,000	2,100,000	5,515,000	4.1
EU 15	2,946,000	1,386,000	2,305,000	6,049,000	4.0

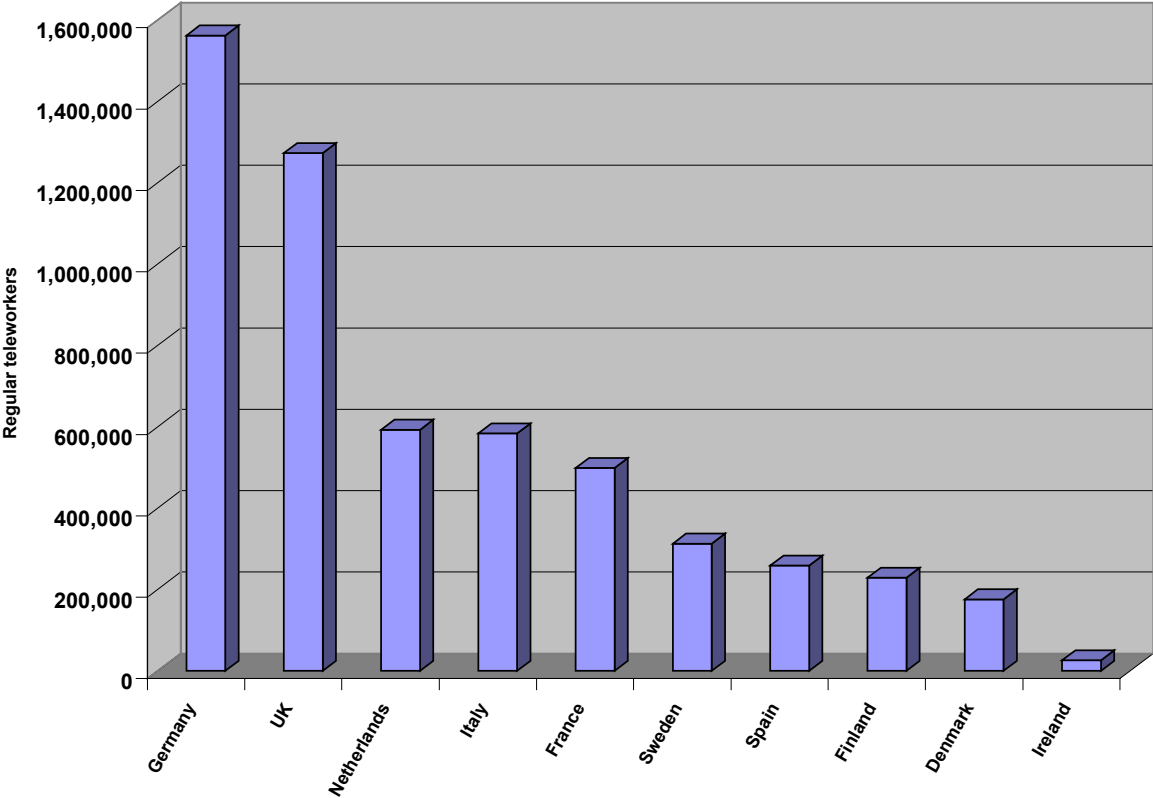
⁴ For more on this topic, visit the ECATT web site: <http://www.ecatt.com/>.

The following are some of the results of those surveys. Of course, one of primary factors in the spread of telework is simply the extent to which workers are aware of it. The first question in our survey, after we determined that the respondent was 18 years old or older and employed—and after we defined telework and telecommuting, was whether the respondent had ever heard of telework. 0.6% of the 1877 people surveyed weren't sure but 73.4% of the rest answered 'yes.' Awareness of telework is higher than that in 5 of the top ten EU countries: Denmark, Finland (93.8%), Italy, Netherlands, and Sweden (93.9%). Apparently the US has some public awareness work to do in that respect.

Table 32 summarizes the results of the 1999 ECaTT (Electronic Commerce and Telework Trends) surveys of teleworkers in the European Union, with specifics for the 10 most developed countries and a total for the entire 15 EU member countries.

Finland, which is by many measures the most wired (or wireless) country in the world, is the clear leader among European countries, on a per-capita basis, in adoption of telework. The Netherlands and Sweden take second and third place, respectively, followed by the UK and Germany. These relationships are shown in Figures 57 and 58.

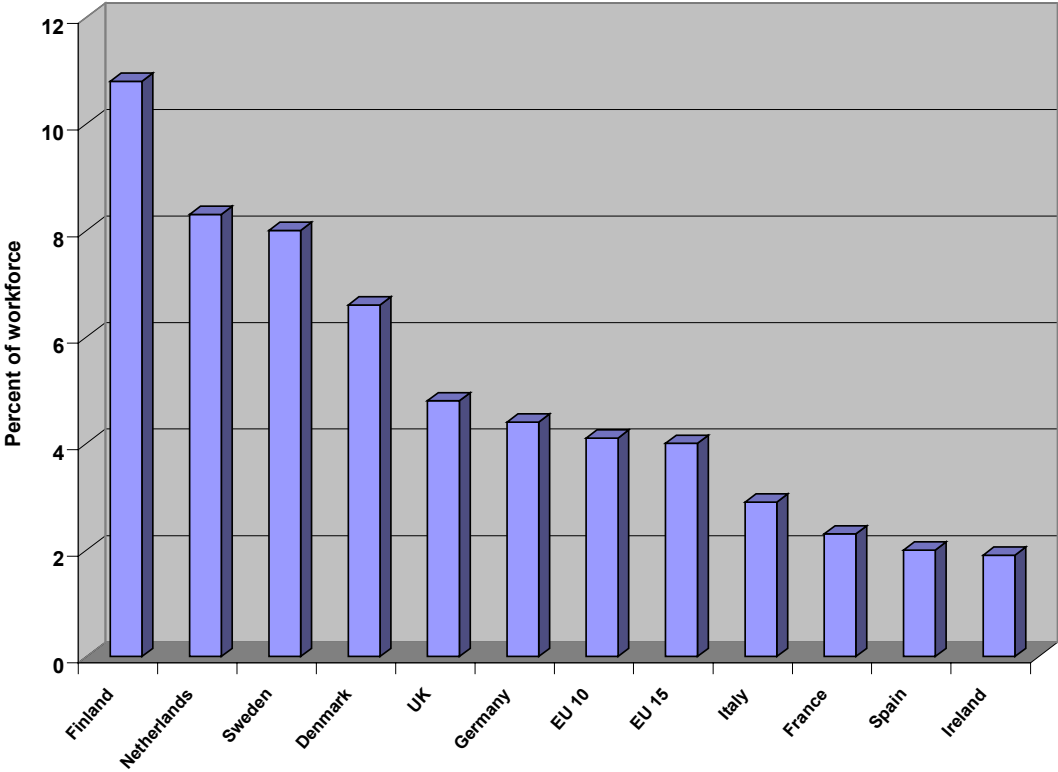
Figure 57: Number of people performing any kind of regular telework in 10 EU countries, 1999



The definitions of telework used for the ECaTT survey are more restrictive than those used for this survey, at least in terms of the frequency required to be classified as **regular** telework. If we similarly limit analysis of our results we can categorize regular home-based teleworkers as *home-based teleworkers who work at home at least one full day per week*.

Under this definition *this year's number of regular US home-based teleworkers is 8,353,000*. This is just about double (93% more than) the number⁵ for 1999 in the 15 EU countries. If we expand the definition to include all US teleworkers who do so at least one full day per week, the total grows to 9,255,000, 53% larger than the ECaTT totals for the 15 EU countries in 1999. This number also equates to 6.8% of the US workforce (putting the US between Sweden and Denmark—and well below Finland—in terms of proportional national adoption of telework).

Figure 58: European regular teleworkers as percent of the workforce, 1999



The ECaTT surveys listed those who, for example, teleworked less than one full day per week as supplementary teleworkers. It also includes some forms of mobile telework and “telecooperation” that were not covered in our survey. An adaptation of our survey to these terms would include the rest of our teleworkers; however, the total for the US is likely to be an undercount relative to the ECaTT survey. In any case, the ECaTT results are duplicated in Table 33 and Figures 59 and 60.

As in the case for the regular teleworkers, the US teleworkers in our survey far exceed the EU teleworkers in numbers (by 83%), but possibly⁶ take fourth place in the percentage of the country’s workforce that they represent.

⁵ The sum of home-based and self employed in SOHO teleworkers

⁶ The “possibly” refers to the types of telework represented in the EU survey but not ours.

Table 33: European regular and supplementary teleworkers, 1999

	Numbers			Percent of workforce		
	Regular teleworkers	Supplementary teleworkers	Total, including supp.	Regular teleworkers	Supplementary teleworkers	Total, including supp.
Denmark	176,000	104,000	280,000	6.6	3.9	10.5
Finland	229,000	126,000	355,000	10.8	6.0	16.8
France	499,000	136,000	635,000	2.3	0.6	2.9
Germany	1,562,000	570,000	2,132,000	4.4	1.6	6.0
Ireland	26,000	35,000	61,000	1.9	2.6	4.4
Italy	584,000	135,000	720,000	2.9	0.7	3.6
Netherlands	593,000	451,000	1,044,000	8.3	6.3	14.5
Spain	259,000	97,000	357,000	2.0	0.8	2.8
Sweden	313,000	282,000	595,000	8.0	7.2	15.2
UK	1,273,000	754,000	2,027,000	4.8	2.8	7.6
EU 10	5,515,000	2,690,000	8,205,000	4.1	2.0	6.1
EU 15	6,049,000	2,960,000	9,009,000	4.0	2.0	6.0

Figure 59: Numbers of regular and supplementary EU teleworkers, 1999

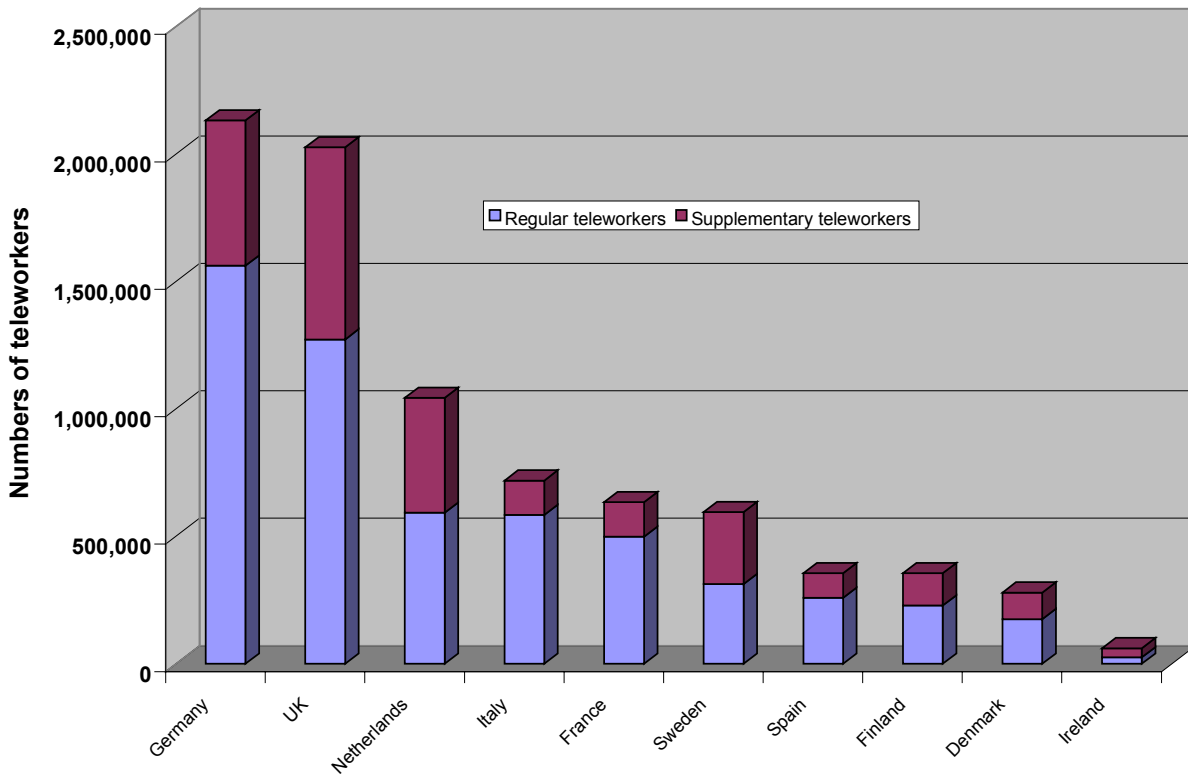
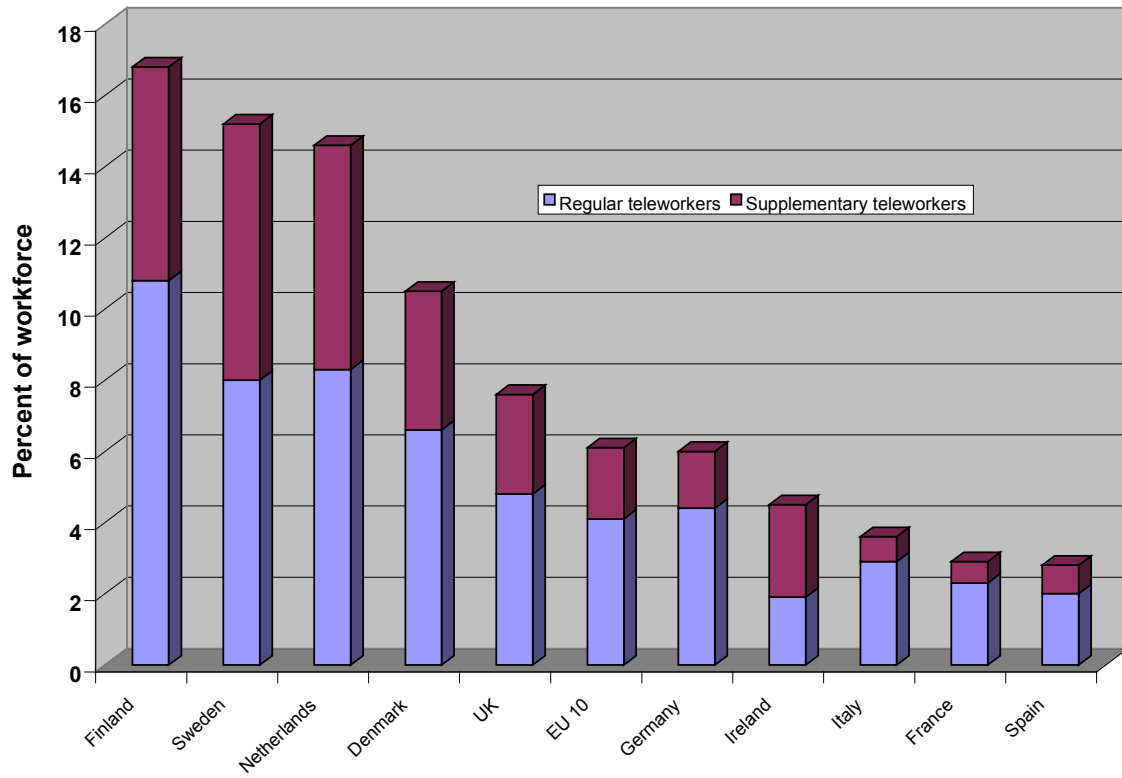


Figure 60: Regular and supplementary EU teleworkers, as percent of the workforce, 1999

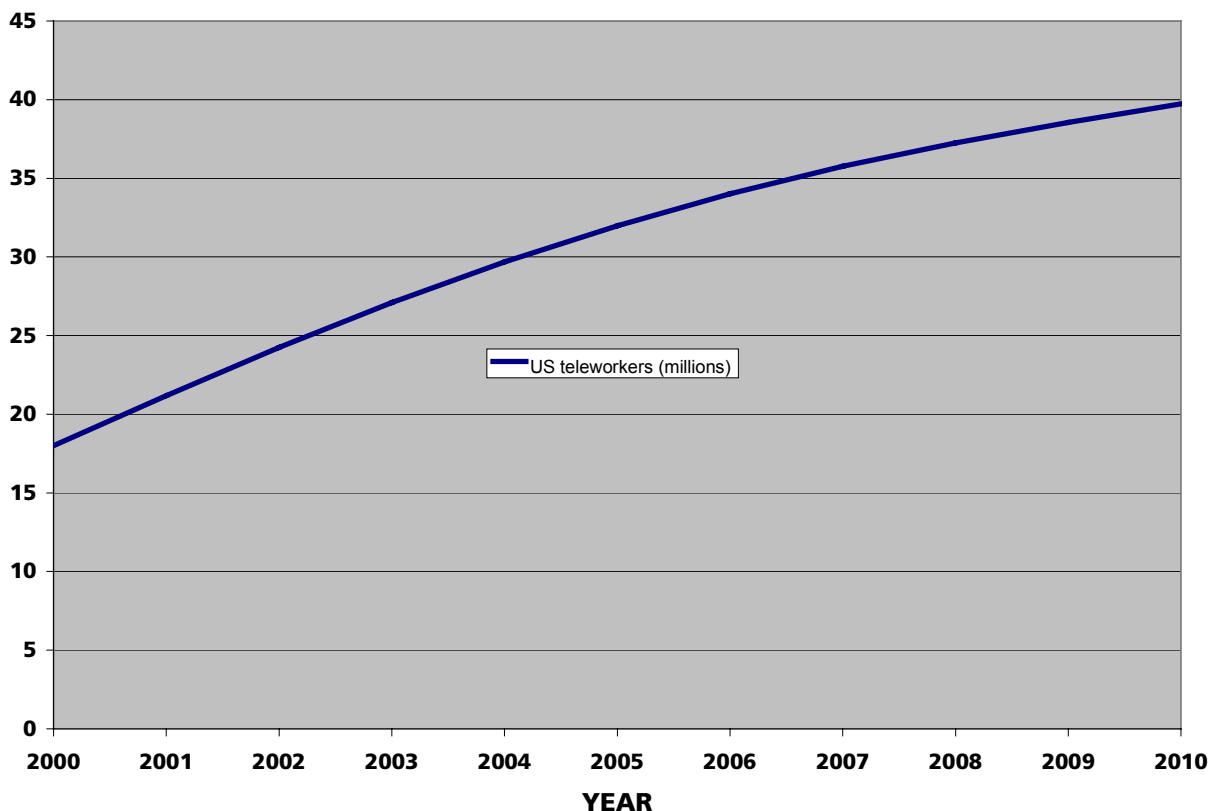


A Look At The Future

As the old saw goes: “It’s very difficult to make predictions—especially about the future.” Still, we have been at it for some time, with reasonable success. I have modified my long-standing forecast about the future of telework in the US as a consequence of the better detail about reality embodied in this survey.

Figure 61 shows my forecast for the next decade. Note that in this forecast the projected number of US teleworkers, including those at telework centers, is likely to reach 30 million at yearend 2004, and 40 million at yearend 2010. It also includes the assumption, based on data from this survey and analysis of prior surveys, that the number of teleworkers in the US will reach about 18.3 million at the end of this year (2000). That number is exclusive of retirees and homemakers who occasionally work at home. All the annual numbers shown are year-end values.

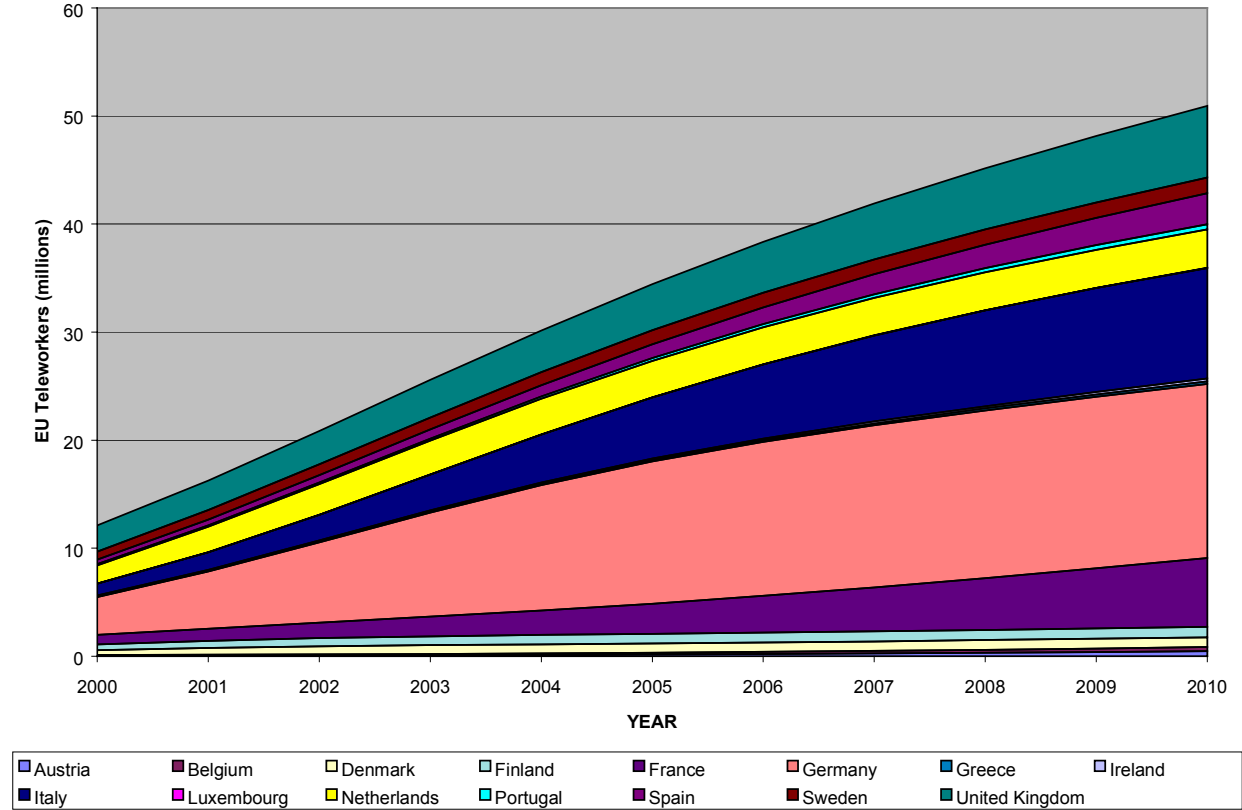
Figure 61: The Telework America 2000 forecast



However, please be advised that a *forecast* is not a *prediction*. Figure 61 depicts the median expected value of the impending realities of the next decade. I can guarantee that there will be deviations from it, although hopefully not major ones. This curve has a shape similar to what appears to be going on in Europe and implies a fairly steady growth for the next decade.

For comparison purposes, I have also made a rough forecast of the growth in the number of teleworkers in the 15 EU countries between 2000 and 2010. That is shown in Figure 62. The forecast is based on the ECaTT data as well as our own independent analyses. The message here is that, if this forecast is even roughly correct, the EU countries will reach 30 million teleworkers at about the same time that the US does. They will reach 40 million before the US does.

Figure 62: Forecast number of teleworkers in the 15 European Union Countries



Appendix 1: Methodology

The information contained in this report is based on 1,877 in-depth telephone interviews conducted with employed U.S. residents 18 years of age or older. Household selection on this project was accomplished via a computer-generated pure unweighted (EPSEM) random digit dial (RDD) telephone sample that selects households on the basis of telephone prefix. This method was used because it ensures a randomly selected sample of households proportionately allocated throughout the sample universe. This method also ensures that all unlisted and newly listed telephone households are included in the sample. A pre-identification screening process was also utilized on this project. This computer procedure screens the sample to remove known business and commercial telephone prefixes in addition to disconnects, faxes and computers. This process greatly enhances contacts to residential telephones.

General Procedure

This survey employed a multi-stage sampling process. The first step in this process was to stratify the subarea samples (U.S. census regions) according to the current population residing in each area. Telephone households were then selected within those areas using the RDD methodology. A probability sample developed in this manner samples proportionately relative to an area's distribution of the population. This strengthens the ability of the sample to be compared with Census data and other demographic information. Table 34 shows the breakdowns.

Table 34: Survey coverage

Census Division	% Of U.S. Population	Completed Interviews	% Of Total
New England	5.0%	94	5.0%
Mid Atlantic	14.2	263	14.0
South Atlantic	18.3	344	18.3
East South Central	6.1	119	6.3
East North Central	16.4	306	16.3
West South Central	11.2	209	11.1
West North Central	6.9	129	6.9
Mountain	6.3	121	6.5
Pacific	<u>15.6</u>	<u>292</u>	<u>15.6</u>
	100.0%	1,877	100.0%

Interviewing on this study was conducted during an approximately equal cross section of afternoon, evening and weekend hours. This procedure was followed to further

ensure that all residents were equally represented, regardless of work schedules. Further, during the interviewing segment of this study, up to six separate attempts -- on different days and during different times of day -- were made to contact each selected household. Only after six unsuccessful attempts was a selected household substituted in the sample. Using this methodology, the full sample was completed, and partially completed interviews were not accepted, nor counted toward fulfillment of the total sample quotas.

Interviewing (CATI). The Behavior Research Center uses the ACS-QUERY CATI system. The CATI system is a computer controlled interview that uses a tightly-integrated branching pattern to control cuing and display of contingent questions. This system allows for a more relaxed interview environment, while reducing the risks of coding error typically found with hard copy survey instruments. The system also performs internal consistency checks on survey variables and prompts interviewer staff to ask probe questions or clarify answers.

Using RDD on the CATI system, when a residential contact was established, the interviewer introduced her/himself and the study, elect the appropriate household member, and attempt to complete the interview with the designated respondent. If the respondent was not at home or if the call was at an inconvenient time, the interview was rescheduled.

The questionnaire used in this study was pre-tested with a randomly selected cross-section of U.S. residents. The pre-test focused on the value and understandability of the questions, adequacy of response categories, questions for which probes were necessary, and the like. No changes were recommended to the questionnaire following the pre-test.

All of the interviewing on this project was conducted between July 17 and August 9, 2000. All of the interviewers who work on this project were professional interviewers of the Behavior Research Center. Each had prior experience with BRC and receive a thorough briefing on the particulars of this study. During the briefing, the interviewers were trained on (a) the purpose of the study, (b) sampling procedures, (c) administration of the questionnaire, and (d) other project-related factors. In addition, each interviewer completed a set of practice interviews to ensure that all procedures were understood and followed.

Table 35: Survey response totals

	Before Quotas Imposed		Full Study Sample	
	N	%	N	%
Telework from home only	134	10.2	256	13.7
Use telework center only	17	1.3	19	1.0
Both home- and center-telework	9	0.7	10	0.5
Neither	1,149	87.8	1,592	84.8
Total	1,309	100.0	1,877	100.0

This study was designed to ensure that a minimum of 250 teleworkers were interviewed. This was accomplished by implementing teleworker quotas on the sample after completion of the first 1,309 interviews. At the point when these quotas were implemented, a total of 12.2 percent of the sample were teleworkers and telework center users. Upon completion of the study, a total of 15.2 percent of the sample were teleworkers and telework center users. These details are in Table 35.

One hundred percent of the completed interviews were edited, and any containing errors of administration were pulled, the respondent re-called, and the errors corrected. In addition, 15 percent of each interviewer’s work was randomly selected for monitoring to ensure its authenticity and correctness. No problems were encountered during this phase of interviewing quality control.

As the data collection segment of this study was being undertaken, completed and validated interviews were turned over to BRC’s in-house coding department. The coding department edited and coded the interviews. Upon completion of coding, a series of validity and logic checks were run on the data to ensure it was “clean” and representative of the sample universe.

All surveys are subject to sampling error. Sampling error, stated simply, is the difference between the results obtained from a sample and those which would be obtained by surveying the entire population under consideration. The size of sampling error varies, to some extent, with the number of interviews completed and with the division of opinion on a particular question.

An estimate of the sampling error range for this study is provided in the following table. The sampling error presented in the table has been calculated at the confidence level most frequently used by social scientists, the 95 percent level. The sampling error figures shown in the table are average figures that represent the maximum error for the sample bases shown (i.e., for the survey findings where the division of opinion is approximately 50%/50%). Survey findings that show a more one-sided distribution of opinion, such as 70%/30% or 90%/10%, are usually subject to slightly lower sampling tolerances than those shown in Table 36.

As may be seen in the table, the overall sampling error for this study is approximately ± 2.3 percent when the sample is studied in total (i.e., all 1,877 cases). However, when subsets of the total sample are studied, the amount of sampling error increases based on the sample size within the subset. For example, the subset of 256 home-based teleworkers in this study has a sampling error of ± 6.2 percent.

Table 36: Typical survey sample errors

Sample Size	Approximate Sampling Error At A 95% Confidence Level (± Percentage Of Sampling Tolerance)
1,877	2.3
1,500	2.6
1,000	3.2
500	4.5
250	6.3
100	10.0

Scaling the findings

The data providing the basis for analysis in this survey were collected as just described. The database consists solely of responses from individuals who were 18 years of age or older and were gainfully employed, either full- or part-time when the survey was made. Since, for fundamental economic reasons, it was not possible to

survey *all* US workers, we were restricted to a sample of 1,877 individuals. Furthermore, the strictly random portion of our sample population consisted of 1,309 individuals. The approximate sampling error for that number is 2.76%.

To get an estimate of the number of teleworkers in the US, simply multiply the number of employed workers in the US by the fraction of teleworkers in our sample population. According to the Bureau of Labor Statistics, the US employed civilian workforce in July 2000 was 135,200,000. Therefore, I estimate that there were 16,526,000 US teleworkers at the beginning of August 2000, when the survey was completed. That is,

$$USTwker s = (SampleTwker s * CivWkforce) / SampleSize$$

$$\begin{aligned} \text{US teleworkers} &= (160 \times 135,200,000) / 1,309 \pm 2.76\% \\ &= \mathbf{16,526,000 \pm 457,000} \end{aligned}$$

Thus, the likelihood is 95% that there were between 16,068,000 and 16,983,000 US teleworkers at the end of July 2000.

Some prior survey results have listed larger numbers than this, thus promoting higher expectations. For example, the 1999 Telework America survey quoted the number of teleworkers as 19.6 million. The respondent selection portion of the 1999 Telework America survey was very similar to that used in this one, with one important difference: retirees and homemakers who did occasional paid work at home were included in the 1999 survey but not in this one. Therefore, this survey is more conservative than the 1999 survey. If the definition for this year's survey were recast to include all the types of teleworkers reported in the 1999 survey, then the total might reach as high as 23.6 million, if all the other conditions were the same. However, since we did not include that group in our survey, and do not know about changes in their conditions, those numbers are simply rough estimates. This lack of congruence also affects our growth estimate, which I put at roughly 21% over the 1999 estimate of employed teleworkers, since we also do not know how many, if any, teleworkers have ceased doing it.

In any case, the estimate of US teleworkers can be broken down as shown in Table 37.

Table 37: Estimate of the numbers of teleworker by telework mode

Telework mode	Estimated number of US teleworkers in July 2000 (millions)
Home-based only	13.8
Telework center-based only	1.8
Both home- and telework-center-based	0.9
Total	16.5

On the other hand, the 1999 Telework America and earlier surveys did not include telework-center teleworkers. The 2000 survey was made primarily in July, while the 1999 survey was made from mid-August to mid-September. Hence, there also may be differences in the two because different fractions of the workforce may have been away on vacation, hence failed to answer our phone calls, during the different periods. In conclusion, most surveys, including this one, should be considered as indicators of reality, rather than gospel, at least past the first one or two significant figures.