

AN INVESTIGATION OF THE IMPACTS  
OF REMOTE WORK ENVIRONMENTS  
AND SUPPORTING TECHNOLOGY

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## BACKGROUND

The subject of this study is the phenomenon of remote work, which refers to organizational work performed outside of the normal organizational confines of space and time. The premise of the research is that remote work will become increasingly important in the future as it expands to include full-time organizational members working remotely on a regular basis for at least part of the regular work week. From the organization's perspective, remote work may include physically decentralized "satellite work centers" and "neighborhood work centers" as well as work at home [12]. The extreme case of remote work would be an employee who works at home full time.

Computer and communications technology may permit more jobs to be performed remotely than were possible before. The terms "telecommuting" [22] and "telework" [16] have been used to refer to work performed remotely augmented by computer and communications technology. Often the implication of these terms is that the work is performed at home; thus "telecommunications" is substituted for "commuting". It has been estimated that as many as 50 percent of all office work could be performed at or near employees' homes rather than at a central office location, with considerable savings in energy costs [12]. The general term "remote work" as utilized throughout this document suggests a broader set of alternatives than that suggested by "telecommuting".

The idea of remote work is of course not new. Full-time work at home is common today for many independent workers such as crafts people, artists, writers, and independent professionals (generally

without computer support). Salespeople regularly work remotely from their organizational facilities because of requirements to spend extensive amounts of time with their clients, often utilizing their homes as their primary offices.

There now exists a significant movement in high-technology firms (i.e., computer hardware and software vendors) to encourage professional employees to use computer terminals or microcomputers to work at home outside of normal work hours. Until recently, however, few business organizations have given their employees the opportunity to work at home on a regular basis.

The utilization of remote work options for organization members has important implications for individual productivity, social interaction, and professional development that are not well understood. These options also provide important alternative choices for the rapidly changing structure of family and work life (see, for example, [9,19]). Furthermore, the role of computer and communications technology in remote performance evaluation and work-related communication needs to be examined. From the individual's perspective, the acceptance of remote work options will entail a complex set of behavioral and attitudinal changes in the traditional view of separation of work and nonwork (see, for example, [12]). For these reasons, remote work must be the subject of extensive research and evaluation before it becomes a widespread phenomenon.

This study focuses specifically on the extreme case of remote work: work at home. This extreme case is likely to have a more profound impact than other forms of remote work such as satellite work

centers. For instance, the relationship between the work and nonwork domains for the individual employee (e.g., social isolation, family interruptions, leisure time), the relationship of the organization to its employees (e.g., the nature of supervision, problems of absenteeism and tardiness), and the nature of the job itself may be changed by the implementation of work at home. In terms of time, the focus is on work performed remotely on a regular basis at least part time, rather than occasionally or after regular work hours. Furthermore, the study is concerned with full-time organizational members rather than independent consultants or contract workers. The role of computer and communications technology as a facilitator of remote work and remote supervision is stressed.

#### MAJOR RESEARCH QUESTIONS

The general objective of the study is to gain insight into the implications of remote work for "quality of work life". The primary concern is individual reactions to remote work rather than broader implications for community structure, energy consumption, or transportation needs; these issues have been addressed in earlier work on telecommunications-transportation tradeoffs [12,16,22]. This objective will be accomplished through empirical analyses of situations where full-time organizational employees are working at home on a regular basis, augmented by computer and communications technology. The study will be further limited to employees occupying professional, as opposed to clerical, positions.

The specific research questions to be investigated fall into three research areas:

1. Impact on performance;
2. Impact on individual attitudes toward work;
3. The role of computer and communications technology in work patterns and supervision.

Research to date by the principal investigator and others has provided basic knowledge about the types of individuals and jobs that are appropriate for work at home as well as its benefits and problems [8,18,25]. This knowledge has been evaluated in the context of well-established theories of work motivation, group performance, and performance evaluation to help identify the set of research questions outlined below. The research design and methods of measurement are described in the section following the research questions.

#### Impact on Performance

1. What is the impact of remote work (i.e., work at home), augmented by computer and communications technology, on productivity as defined by output per unit of time?

Increased productivity of employees working at home has been cited in a number of cases to date [8], including employees in clerical positions with very short turnaround times as well as those doing "professional" project work with long-term deliverables. The general consensus from these examples is that increased productivity results from the minimization of disruptions and ability to concentrate afforded by work at home. The flexibility to choose one's work hours is also hypothesized to contribute to the increase.

2. What is the impact of remote work (i.e., work at home) on perceptions of job characteristics?

The opportunity to work at home may result in certain changes in the nature of the job, simply because of the change in location. For instance, the absence of coworkers may result in assignment to smaller, simpler projects which can be completed independently by the employee working at home.

3. What is the impact of remote work (i.e., work at home) on formalization of supervision and performance evaluation?

Exploratory investigations of supervision of remote workers have suggested that increased formalization of supervision may be associated with remote work [23]. The decrease in opportunity for informal, unscheduled face-to-face interactions with the supervisor may in part explain this tentative finding. Remote employees more frequently gain access to their supervisors through the telephone, electronic mail or written media. Face-to-face contact occurs only at those times when the employee visits the office, and frequently requires a formally scheduled appointment. If the supervisor perceives a loss of opportunity for "hands-on" control, the result may be the establishment of more formal control procedures for the remote employee. Of course, these effects on the supervisory process are highly dependent on the existing personal supervisory style when the employee begins to work at home. Thus, a broader research question will be examined: How is the supervisory process altered to accommodate the remote worker?

Impact on Individual Attitudes

Exploratory findings to date have indicated a number of potential changes in the employee's relationship to work as a result of the shift to work at home, with important implications for attitudes towards the job as well as the nonwork domain.

4. What is the impact of remote work (i.e., work at home) on employee job satisfaction?

The relationship between remote work and employee job satisfaction is a complex one. One of the chief objectives of this research is to define the moderating variables and generate a series of hypotheses which will describe this relationship. (For a complete review and discussion of the research on job satisfaction, see [17].) For instance, work at home may have positive implications for autonomy over scheduling of work, which has been related to increased job satisfaction (see, for example, [1,10]). On the other hand, some organizations have switched to piece rate systems or defined minimum levels of output for employees working at home. This might result in a perceived decrease in autonomy over the rate of production with negative implications for job satisfaction.

5: What is the impact of remote work (i.e., work at home) on the overall life satisfaction of the employee?

Although it is difficult to objectively examine the effect of work at home on the employee's nonwork (i.e., family) life, exploratory information on changes in the nonwork domain of the

employee will be obtained through interviews with close family members as well as the employee. For a discussion of the relationship between job satisfaction and life satisfaction, see [26].

6. What is the impact of remote work (i.e., work at home) on the organizational commitment of the employee?

Organizational commitment has been demonstrated to be strongly related to absenteeism and turnover [20]. Commitment is relevant to this study because certain of its antecedents may be influenced by the work site. For example, social interaction and social involvement, presumably stemming from high group interaction and cohesiveness, have been shown to be positively related to commitment [3,29,31]. This suggests that the reduced opportunity for group interaction among employees working at home may have negative implications for commitment and ultimately for turnover. Informal evidence from exploratory studies indicates that decreasing commitment to the organization coupled with an increased sense of autonomy and flexibility may result from the work-at-home situation [8,25].

7. What is the impact of remote work (i.e., work at home) on individual stress?

The origins of work-related stress are complex [7]. Informal evidence from exploratory studies indicates that, for some employees, removal from the work environment reduces stress [8]. Other nonwork-related inducers of stress, such as commuting, have been noted by employees who reduced or eliminated the need to commute. For employees who assume or maintain additional nonwork-related



responsibilities in the home, work at home may tend to increase overall stress [8].

8. What is the impact of remote work (i.e., work at home) on the job involvement of employees?

Job involvement results from achieving high standards of performance, or job success, and has been associated with both level of autonomy and job satisfaction [11, p.126]. Because of the hypothesized impact of remote work on these two variables, it follows that job involvement is relevant for study as well. Little research on job involvement has dealt specifically with the work environment, however. Evidence from exploratory studies suggests that lack of physical separation from work may lead to increased attachment to the employee's work-related responsibilities and signs of "workaholism" [8].

#### The Role of Computer and Communications Technology

A central component of the study is the analysis of the importance of computer and communications technology in the remote work environment. A great deal of research has been completed to date on the role of communications media in group process and task accomplishment (see [32] for a review). This study provides a more qualitative analysis of the uses of technology in day-to-day work. Technology is expected to play three important roles in the implementation of remote work:

1. As a substitute for other forms of communication with supervisors and coworkers,

2. As a management tool for performance evaluation and monitoring,
3. As a mechanism for obtaining information necessary to perform one's job.

Note that the first two of these describe the process by which the management and control process changes. The third will have implications for the employee's perceptions of job characteristics.

#### ANTECEDENTS OF WORK AT HOME

Exploratory research has indicated that the proposed outcomes are highly dependent on the choice of individuals to work at home and the choice of jobs to be performed. Three classes of antecedent variables are examined: individual characteristics, job characteristics, and situational characteristics.

##### Individual Characteristics

In a strictly exploratory vein, one personality characteristic of the employees will be investigated. Locus of control, or the extent to which individuals perceive that what happens to them is controlled by themselves (internal) or by forces external to themselves (external), has been frequently employed to differentiate those who act on their environment versus those who respond passively to events [30]. One implication of this research is that those with external locus of control must be more actively supervised than those with internal locus of control. Given the freedom from constant supervision and other organizational constraints inherent in the work-at-home situation, locus of control is thus relevant to this investigation. The initial results on locus of control from this study should help to formulate hypotheses concerning the selection process for work-at-home employees.

### Job Characteristics

The following characteristics of the job and the work environment have been identified as characteristic of remote work through previous research by the principal investigator [8,25]:

1. Minimal physical requirements with respect to equipment and space.
2. Individual control over work pace. Project-oriented work with long term completion dates appears to allow this control.
3. Well-defined deliverables. Tasks have clearly defined and well understood specifications as well as mutual agreement between the manager and the employee as to what constitutes a completed task.
4. Well-defined milestones. Consistent with well-defined deliverables, the tasks have clearly defined and self-contained milestones which serve to mark the progress of the employee. This is particularly important in tasks which take considerable time to complete.
5. Need for periods of uninterrupted work time. Tasks which require concentration for extended periods of time are ideally suited to many work at home environments.
6. Low requirement for frequent communication with others. Successful task performance does not depend on contact with others; the task can be completed relatively independently of external input.

It should be noted that use of computer and communications technology is NOT one of these characteristics. However, programming and other jobs related to system development (e.g., documentation specialist) fit the listed criteria rather well. It is these characteristics, and not the use of the technology per se, that make these jobs potentially good candidates for remote work.

### Situational Characteristics

Situational characteristics of the employee have been shown to have an effect on the success of the home work arrangement [8,25].

These are the following:

1. Space. Ideally, the employee has adequate work space which is separable from nonwork activities.
2. Nonwork-related responsibilities, primarily family care. Preliminary evidence shows that employees with primary family care responsibilities react differently to the work-at-home situation than those for whom it is a secondary responsibility. For instance, employees in [8] who scheduled work around full-time child care experienced increased stress while others in the group experienced decreased stress levels.

#### GENERAL PLAN OF STUDY

The study has two components: quasi-experimental field studies of work-at-home pilots in organizations and survey research across organizations of employees currently working at home. Both components are described in detail below.

##### Pilot Studies

This component of the study takes the form of a series of small quasi-experimental field studies [5]. The nature of the study must be termed exploratory since the total sample size is small. Further, because it takes place in naturally-occurring experimental settings, the degree of experimental control is limited. This approach allows formulation of a model describing the relationships between relevant variables, which will then be available for testing through more narrowly focused research.

The researchers are helping to initiate and implement several "pilot programs" of organization members working at home on at least a part-time basis. Each pilot program is studied over a period of six

to nine months or until its termination, whichever occurs first. For each pilot, a roughly equivalent (in terms of job characteristics and responsibilities) control group of non-participants is identified and similarly tested. The experiments thus take the form of a series of small "nonequivalent control group designs" [5]. The goal is to study four to five pilot programs of four to six participants each, with an equivalent number of participants in the control groups.

The following criteria are used for selection of candidate pilot programs:

1. Participants must be full-time employees;
2. Participants must work at home on a regular basis at least two days a week;
3. Participants must have access to computer and communications technology in their homes and must utilize it for their work.
4. Participants must be classified as professional/managerial employees rather than clerical.

With respect to the last criterion, in very general terms, jobs may be divided into two categories: professional/managerial and clerical. The treatment of such issues as performance evaluation and compensation differs sharply between the two categories. Technological requirements and individual needs are also expected to differ. In terms of this research, therefore, few generalizations can be made to all forms of work; for practical reasons the study is limited to professional employees. (This choice is not meant to be taken as an indication that clerical employment is not an interesting subject of study; on the contrary, it is critical that further research concerning the impact of remote work on clerical workers be undertaken.)

Three different kinds of data are collected in the pilot studies:

1. Pre- and post-pilot interviews of participants (and control group), their families (if applicable) and their managers;
2. Pre- and post-pilot attitude questionnaires;
3. Daily logs of work schedules and communications modes utilized.

Although companies experimenting with work-at-home pilots have evaluated them, no evaluations have provided comparative data across pilots. The ability to compare across organizations will be a major contribution of this study, even though the total sample size is small. The individual results of each pilot will also be reported.

#### Survey Research

In an effort to expand the base of comparative data, the study will also include organizational members who are working at home on a regular basis but not as part of a formal pilot program. In the survey the same interview formats and attitude questionnaires are utilized as in the pilot programs. However, no attempt is made to collect "before-after" data, to obtain activity logs, or to provide a control group for comparison. Potential subjects must meet the four criteria set for participants in the pilot studies. The goal is to collect data from approximately one hundred such employees.

There are two practical reasons for turning to survey research to expand the pool of available data. The first reason is that in attempts over the last year to identify potential pilot studies, the principal investigator has found that few such programs actually exist or are intended, although many organizations claim to be studying the issue (see [4]). Second, during the same exploration, the principal

investigator has discovered that many organizations do in fact have employees working at home on a regular basis. They are not part of formal pilot programs and the arrangements are left explicitly informal so that questions regarding human resources policy will not be raised.

#### Data Collection Procedures

The instruments for both the pilot studies and the survey have been developed and pre-tested in a pilot study at a major bank [24].

For the pilot studies, interviews are conducted and questionnaires completed prior to beginning and after completion of the pilots. The survey respondents complete the questionnaires once. The specific information to be obtained and the type of instrument to be used are described below:

1. Background interviews: participant employees and control group. Background data is obtained on the following:
  - Work experience
  - Job description
  - Home situation
  - Use of computer and communications technology for work-related tasks
  - Performance evaluation mechanisms
  - Commuting situation
  - Opinions about work at home
2. Background interview: managers of employees
  - General information about responsibilities and procedures
  - Formal control procedures
  - Management procedures



- Opinions about work at home
- 3. Background interview: employee's spouse/roommate
  - Home situation
  - Division of non-work responsibilities
  - Opinions about work at home
- 4. Attitude questionnaires: participant employees and control groups
  - a. Locus of Control [30]. Locus of control refers to the degree to which the individual perceives that rewards follow from, or are contingent upon, his or her own behavior versus the degree to which the reward is controlled by forces beyond his or her control.
  - b. The Job Description Index [33]. This index measures satisfaction with the job along pure dimensions: the work itself, supervision, coworkers, pay and promotions.
  - c. Life Satisfaction Questionnaire [28]. This questionnaire measures life satisfaction as assessed through a number of specific moods or affects. Life satisfaction is the overall attitude about both work and nonwork and the way in which these interact.
  - d. Organizational Commitment Questionnaire [20]. This questionnaire addresses the extent to which the employee feels a sense of commitment and loyalty to the organization.
  - e. Job Diagnostic Survey [10]. This survey measures the characteristics of jobs along the following dimensions: autonomy, feedback, skill variety, task identity, and task significance.
  - f. Job Involvement Scale [15]. This instrument has two subscales measuring the importance of the job to the employee and the role of work in the employee's life.
  - g. Organizational Stress [2,6,27]. This instrument contains questions on physiological symptoms of stress as well as some of its predicted antecedents: role conflict, role ambiguity, relationships with others, organizational climate, and career development.
- 5. Daily logs. Participants in the pilot programs and the control groups complete daily logs on a random selection of days covering one-third to one-half of the actual work days during the pilot. Logs are of two types:
  - a) Activity logs. These are completed at the end of a work day. They capture the employees' daily work schedules and self-evaluations of their performance.
  - b) Communications logs. These tabulate both the quantity



and mode (e.g. face-to-face, electronic mail, telephone) of all work-related communications in which the employee engages throughout the work day.

#### CURRENT KNOWLEDGE OF REMOTE WORK

##### Pilot Programs

Most current understanding of the problems and opportunities posed by remote work is based on limited experiments with pilot programs in business organizations. Several companies, including Control Data Corporation, Travellers Insurance [16], and Southern New England Telephone [8], have been experimenting with satellite work centers on a limited basis. Others have experimented with work at home on a limited basis [4,8,21]. Overall, the results of these studies show modest to dramatic productivity gains with minimal cost to the companies. Probably the largest such trial has taken place at Control Data Corporation, where over seventy full-time professionals have worked at home on a regular basis from one to five days a week. Preliminary results have shown substantial cost and time savings to the individual (primarily from elimination of commuting) and no decrease in productivity [8]. Control Data is now investigating legal, tax, and benefits issues that would affect participants, and is also instituting training programs in remote management.(1)

Other companies have also experimented with pilot programs, notably Continental Bank of Illinois, Blue Cross/Blue Shield of South

(1) This information was obtained through personal correspondence with R.A. Manning, General Manager of Office Technologies at Control Data Corporation, and "company private" reports. It is not available for publication.

Carolina, Mountain Bell, and Investors' Diversified Services. With the exception of Control Data, however, these pilots have involved no more than five employees at a time. No attempt has been made to date to compare the at-home employees to an on-site control group. None of these pilots has dealt specifically with the behavioral effects and attitudes of the worker and his/her family, nor have they examined the long-term effects of remote work on career paths or professional development.

#### Industrial Home Work

Some comparisons have been made between clerical jobs performed at home and industrial home work, which describes performance (at home) of relatively unskilled tasks paid on a piece-rate basis. A recent study of the apparently large "subterranean" industry of home sewing in Canada [13] documents widespread abuses of home workers by their employers. These include low pay, lack of benefits, imposition of unrealistic deadlines, and lack of enforcement of government regulations. Industrial home work is viewed negatively by labor unions, as indicated by the following quotation from [13]:

All clothing workers are threatened by the existence of one category of workers who work under substantially poorer conditions than do the regular labour force. The rise in the prevalence of homework is a symptom of the weakening power of the labour unions in this country.

The position of the National Association of Office Workers [34] against office automation specifically includes condemnation of work at home for similar reasons. These concerns are addressed in this research study through several approaches:

1. In the pilot studies, the employees chosen to work at home are in most cases members of the organization already, continuing to receive full pay and benefits while they work at home.

2. The investigators emphasize the necessity to consider work-at-home employees as full-fledged organizational members first, with commensurate rights and privileges.
3. In order to help foster this attitude within the organization, a seminar is conducted for each firm at the time of implementation of the pilot for all managers and employees involved. In addition to addressing their roles as participants in the pilot study, the seminar focuses on possible changes in type of supervision, decreases in communications with peers, control procedures, and other changes in the nature of the relationship with the organization.
4. Throughout the course of the pilot, managers and employees are interviewed periodically to monitor and avoid potential problems and abuses of the situation.

One objective of the survey portion of the study is to measure any perceptions of abuse and unfair practices and to report them.

#### Research on Remote Work

Outside of pilot programs such as those described, there has been very little research to date on remote work with technological support and its effect on organizations and individuals. Two studies, one of them by the principal investigator, have been conducted to gather preliminary evidence through interviews with organization members working at home.

McClintock [17] interviewed twenty "telecommuters" (all utilizing computer and communications equipment in their jobs) to determine the effects of work-at-home on their productivity. He found that they experienced greater productivity on routine tasks, primarily because of access to an electronic mail system. His respondents also felt they increased their effectiveness on complex tasks because of fewer interruptions. The primary negative effect was conflict in the home environment. The telecommuters he interviewed felt, somewhat

surprisingly, that they had greater interdependence with coworkers and more effective use of face-to-face contact as a result of their home work arrangement.

The principal investigator interviewed thirty-two people who were employees of five different companies and worked at home at least part time. Only a few had access to computer facilities in their homes. The greatest problem, they felt, was social isolation. While 22 percent felt they were more productive working at home, more (31%) felt that their productivity actually suffered. While many entered into the arrangement in order to facilitate child care, strain on family relations was evident in 38 percent of the cases [8,25].

The principal investigator also conducted an exploratory study of remote management at a major manufacturing organization. She interviewed ten employees who were geographically separated at least part of the week from their managers; she also interviewed their managers. The results, reported in [23] led to the formulation of the hypothesis regarding remote supervision and performance evaluation.

#### COMPLETED WORK ON PROJECT

The principal investigator was awarded a grant by the Information Impacts Program of National Science Foundation (IST-8208451, 7/1/82-3/31/83) to begin pilot testing for the project. Under this grant all instruments were developed or selected, and pre-test data collection was completed in the first organizational pilot study.

Currently, a second organization has begun a pilot and initial data collection has been completed. The principal investigator is continuing negotiations with several other companies to obtain their agreement to participate in the research investigation.

#### DISSEMINATION OF RESULTS

It is expected that several publications in academic journals will result from this study. At least two journal articles will be based on the empirical analysis: one will report on the implications of remote work for organizations and individuals, and the second will focus on the implications of computer and communications technology for remote work. A final report of the study will be supplied to all participating companies.

#### PROJECT SCHEDULE

The project is scheduled to run for two years beginning September 1, 1983. The schedule of initiation of the remainder of the pilot programs is difficult to determine but the target is to have them all completed in the first year of the project. The second year will be devoted to data analysis, reporting of results, and determination of appropriate areas for further study.

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