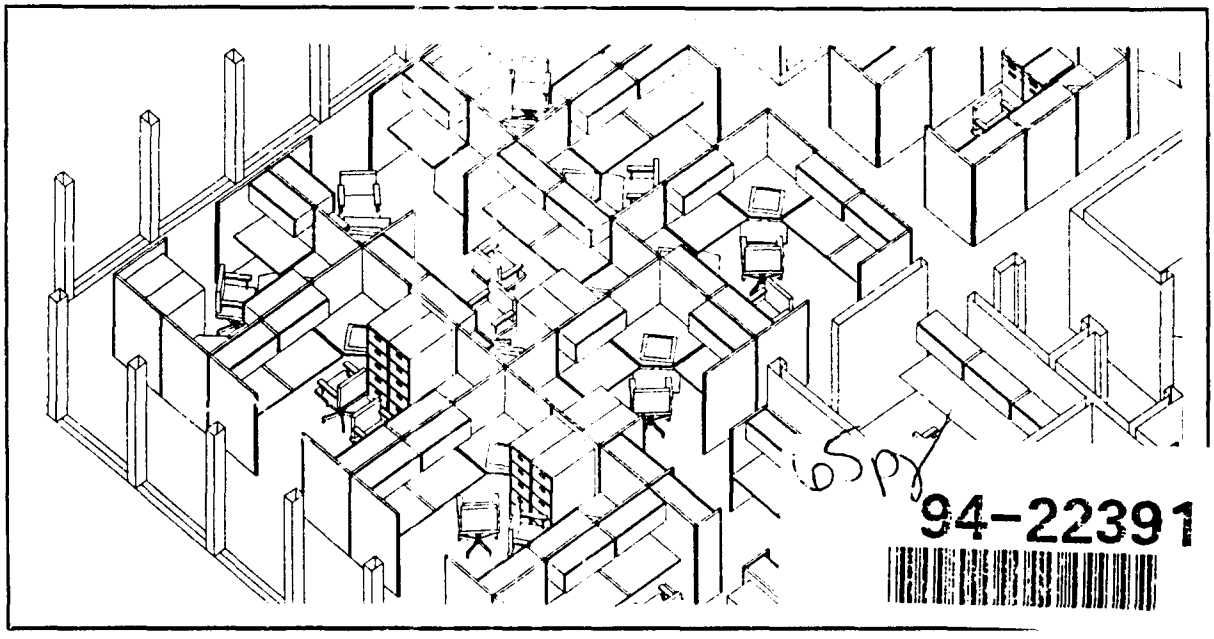
US Army Corps
of Engineers
Construction Engineering
Research Laboratories

USACERL Technical Report FF-94/22
May 1994

Evaluating Office Environments: A Case Study

by
James R. Anderson, Sue Weidemann, Douglas C. Heinen, Blessing F. Adeoye, and Simone Demirjian Beazly



The relationships between the characteristics of the office environment and the behavior and perceptions of individuals working in a particular interior office setting are of interest to the U.S. Army because it is responsible for millions of square feet of office environments. Also, the U.S. Army is interested in maximizing the effective utilization of office spaces and enhancing employee satisfaction and productivity. To investigate what attributes of the facility impact the users' perception of satisfaction and productivity, the responses of employees to their office environment were compared before and after a renovation of their office. Design changes were made to the work space, lighting, heating, ventilating, and air conditioning based on users' needs and requirements.

Conversations, site visits, a survey, and a refined questionnaire were used to obtain specific design information from employees prior to remodeling. The employees completed the questionnaire again after the renovation. More than 22 characteristics of the environment were related to employees' satisfaction with their workstation and can be inferred to relate to productivity. Employees perceived many aspects of their work environment differently after the renovation, and this report discusses specific findings and their implications for the design and management of other office environments.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 1994	Final

4. TITLE AND SUBTITLE
Evaluating Office Environments: A Case Study

5. FUNDING NUMBERS
4A162784
AT41
FA-AF3

6. AUTHOR(S)
James R. Anderson, Sue Weidemann, Douglas C. Heinen, Blessing F. Adeoye, and Simone Demirjian Beazly

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Construction Engineering Research Laboratories (USACERL)
P.O. Box 9005
Champaign, IL 61826-9005

8. PERFORMING ORGANIZATION REPORT NUMBER
TR FF-94/22

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Headquarters, U.S. Army Corps of Engineers (HQUSACE)
ATTN: CEMP-EA
20 Massachusetts Ave., N.W.
Washington, D.C. 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Copies are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The relationships between the characteristics of the office environment and the behavior and perceptions of individuals working in a particular interior office setting are of interest to the U.S. Army because it is responsible for millions of square feet of office environments. Also, the U.S. Army is interested in maximizing the effective utilization of office spaces and enhancing employee satisfaction and productivity. To investigate what attributes of the facility impact the users' perception of satisfaction and productivity, the responses of employees to their office environment were compared before and after a renovation of their office. Design changes were made to the work space, lighting, heating, ventilating, and air conditioning based on users' needs and requirements.

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14. SUBJECT TERMS
office layout
work environment
office environment

15. NUMBER OF PAGES
66

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

Foreword

This research was conducted for the Directorate of Military Programs, Headquarters, U.S. Army Corps of Engineers (HQUSACE), under project 4A162784AT41, "Military Facilities Engineering Technology"; work unit FA-AF3, "Model for Configuring Effective Workplace." The HQUSACE technical monitor was Frank Norcross, CEMP-EA.

The work was performed by the Facility Management Division (FF), of the Infrastructure Laboratory (FL), U.S. Army Construction Engineering Research Laboratories (USACERL). Alan Moore is Chief, CECER-FF, and Dr. Michael J. O'Connor is Chief, CECER-FL. The USACERL principal investigator was Douglas C. Heinen (FA). The research was performed in part by Professor James R. Anderson and Sue Weidemann of the University of Illinois. The USACERL technical editor was Agnes E. Dillon, Information Management Office.

The personnel of the Finance and Accounting Support Office (FASO) of the Humphreys Engineering Center Support Activity (HECSA) are acknowledged for their support and participation in this study. Specifically, Joan MacDonald and Chris Mullens served to facilitate and encourage this research toward a successful design solution. Special appreciation is extended to Todd R. Blain, Angelo Trapani, Julie Testa, and Gary Kinzer (all formerly of the Architecture Team, USACERL) for their contributions in the design and execution of this project; and to Chris Lee of CENAB for accepting the challenge of a new mission in interior design.

LTC David J. Rehbein is Commander, USACERL, and Dr. L.R. Shaffer is Director.

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1 Introduction

Background

The past 20 years have seen a dramatic change in the way work is carried out in office environments. Computer-based word processors have replaced typewriters. Floppy disks and fixed disks have replaced filing cabinets. Fax transmissions have replaced mail. Office equipment that was state-of-the-art 20 years ago may be worthless today.

Likewise, the past 20 years have seen a dramatic change in the way office environments are designed and furnished. Systems furniture is available to replace separate pieces of office furniture. Free-standing panels are available to replace walls. Office designs that were state-of-the-art 20 years ago may be considered worthless today.

In view of these changes, government facility managers have been concerned with the value of adopting new office layouts and furnishings, as well as with adopting new work technologies. As a result, designers of interior environments need information to show managers the relative importance of furnishings, lighting, space, etc., as well as information to show the effect of changes to specific parts of the office environment.

In 1986, the U.S. Army Construction Engineering Research Laboratories (USACERL) began to assess the effects of design changes in office environments with a study of the Defense Construction Supply Center, Columbus, OH (Francis et al. 1986). This study uses some of the same methodology and environmental goals by assessing some of the effects of physical changes at the Humphreys Engineer Center Support Activity (HECSA), Finance and Accounting Support Office (FASO). Specifically, it was hypothesized that informed physical design-related changes in the office environment would have a positive outcome for the users of the office environment.

Objectives

The purposes of this study were to expand on the concepts addressed in 1986 by Francis et al., to test a refined questionnaire, and to examine the effectiveness of a particular office redesign by comparing evaluations of the office space both

before and after changes by a questionnaire and a programming survey or questionnaire.

Approach

Specific characteristics of the work environment were manipulated through the redesign of some work areas. Workers were asked to evaluate their workspace before changes occurred (Time 1) and after they were moved into renovated work areas (Time 2).

The employees were not randomly assigned to new workstations, and it was not possible to control all other potentially intervening variables, thus this research was a quasi-experiment.

The data were obtained through the use of a previously developed, structured questionnaire (Anderson and Weidemann 1992). This questionnaire had been tested on 190 individuals in 12 different buildings and was found to be both reliable and valid. The questionnaire was first administered to all employees of the FASO about 8 months prior to the beginning of construction. At that time 64 of the 81 employees responded. The questionnaire was administered a second time 2 months after the completion of the renovations in October 1992. The questionnaire was distributed to all the employees, and 54 responded. The questionnaire contained a place for the respondent's name, so the questionnaires could be matched with respondents who had been there both before and after the renovation.

Scope

This study focuses on a single work environment. No generalizations can be made from these findings to other work environments. However, there are two ways in which the scope of this study goes beyond the environment examined.

First, general knowledge about the important characteristics of the designed physical environment will result from this collection of individual studies. No single study can contain samples of people and spaces that completely represent the existing work environments. However, generalization occurs when a number of studies of distinct environments, examined by independent researchers, obtain consistent findings. Thus, compared with other studies, this study of a particular location can be of importance beyond the setting in which it occurred, particularly when findings from several work settings are combined.

Second, this study is important beyond the setting in which it was conducted because the results demonstrate that changes to the physical characteristics of a work environment are, indeed, perceived as being important by the individuals working in that environment. Although this relationship seems obvious to many, other researchers in the field remain skeptical.

Past Studies

Studies of the impact of the office environment on workers go back nearly 40 years to the studies of Maslow and Mintz (1956) and Mintz (1956). Those studies showed that an individual performed better in an "attractive" office than in an "unattractive" office. However, they did not identify how specific characteristics of the environment helped an individual perform better, or which characteristics were most important in determining "attractiveness."

Since the work of Maslow and Mintz (1956), and particularly in the past 10 to 15 years, studies have become more focused, including major studies of multiple work environments (e.g., Brill and Margulis 1984), studies that have focused on single issues (e.g., Ellis 1986; Marans and Yan 1989; Menzies et al. 1993), and studies that have looked at multiple issues (e.g., Marans and Speckelmeyer 1981).

Recent Studies

In addition to articles in scholarly and professional journals, a number of recent books have reviewed or summarized the current state of knowledge about office design and its relationship to the behaviors and perceptions of those who use the work spaces. These books range from those with an emphasis on the individual worker and interpersonal relationships (e.g., Sundstrom 1986) to edited collections of individual works covering a wide variety of design-behavior issues (e.g., Wineman 1986). Others represent a more historical look (e.g., Duffy 1992, which is a collection of his writings about the workplace, primarily based in England, over a 25-year period). The number and diversity of the approaches to the study of the workplace attest to the importance of the issues. With lean economic times, an effective, efficient workplace becomes increasingly necessary. This fact has been recognized by private organizations that have sponsored research and publications (e.g., Brill 1990). The Federal government also has sponsored studies of the impact of office environment on workers, including two studies from USACERL. First, Francis et al. (1986) used a quasi-experiment to compare standard furniture to systems furniture. Their study examined changes in a measure of productivity that occurred when the type of office furniture was changed in an office area of about 14 individuals. Systems furniture was found to have a significant, positive impact on productivity and worker satisfaction

measured in terms of the number of tasks completed, the backlog of work, the hours worked, and the amount of sick leave.

Second, Anderson and Weidemann (1992) used multiple office environments to develop a questionnaire for the evaluation of office environments in general. Their study compared responses of workers to characteristics of the environment to actual objective measures of the environment. Correlations between these subjective and objective measures indicate that questionnaire responses about issues of lighting, temperature, etc. are as effective, in terms of understanding the relationships between office characteristics and outcomes, as taking technical instrument measurements throughout a workplace.

Mode of Technology Transfer

This report will be distributed to the U.S. Army Corps of Engineers districts and divisions as well as facility personnel at installations. It also will be part of the curriculum for the U.S. Army Corps of Engineers Proponent Sponsored Engineer Corps Training (PROSPECT) Course, Interior Design I. The survey instrument described in this report is under further development and field testing through the Facilities Engineering Applications Program (FEAP). Enhancements and "proof of instrument" will provide designers, planners, and facility personnel with a usable programming and design tool.

2 Study Method

Setting

The setting for this research was the FASO of the HECSA. These offices are on two floors of a two-story building. Two areas are on the first floor and a third area is on the second floor. Figures 1, 2, and 3 show the floor plans as they existed prior to the involvement of USACERL. The office space was furnished with individual desks, chairs, tables, etc.; some individuals were in partitioned office space and others were in shared open office areas.

USACERL provided design support to HECSA for the renovation of this office space through the U.S. Army Corps of Engineers, Baltimore District. No space was added; the existing space was reorganized and refurnished. The USACERL designers distributed an open-ended questionnaire to all employees (Figure 4). This was done to understand the spatial problems and to ensure that none were overlooked. (Note: the questionnaire was explicit only about issues of equipment and storage.) The questionnaires also solicited information about the office equipment that every individual possessed and equipment that could be provided for in the renovation. Trapani (1992) reported that the surveys became an important element during the design process.

The designers developed a sense that there were a limited number of specific problems in the FASO. This perception was based on their examination of the plans, a visit to the site, and the information on the questionnaires. In retrospect, the plans appear to have revealed the following issues:

- little natural light getting into the open office space,
- basic disorganization of the open office space,
- lack of definition between different divisions, and
- most workers limited to one desk with an attached side work surface.

Five problems confirmed on a visit to the office were:

- inadequate file storage for individuals and groups,
- cables and wires taped to the floors,
- file cabinet locations creating circulation hazards,
- inadequate office light and virtually no task lights, and
- inadequate acoustic quality.

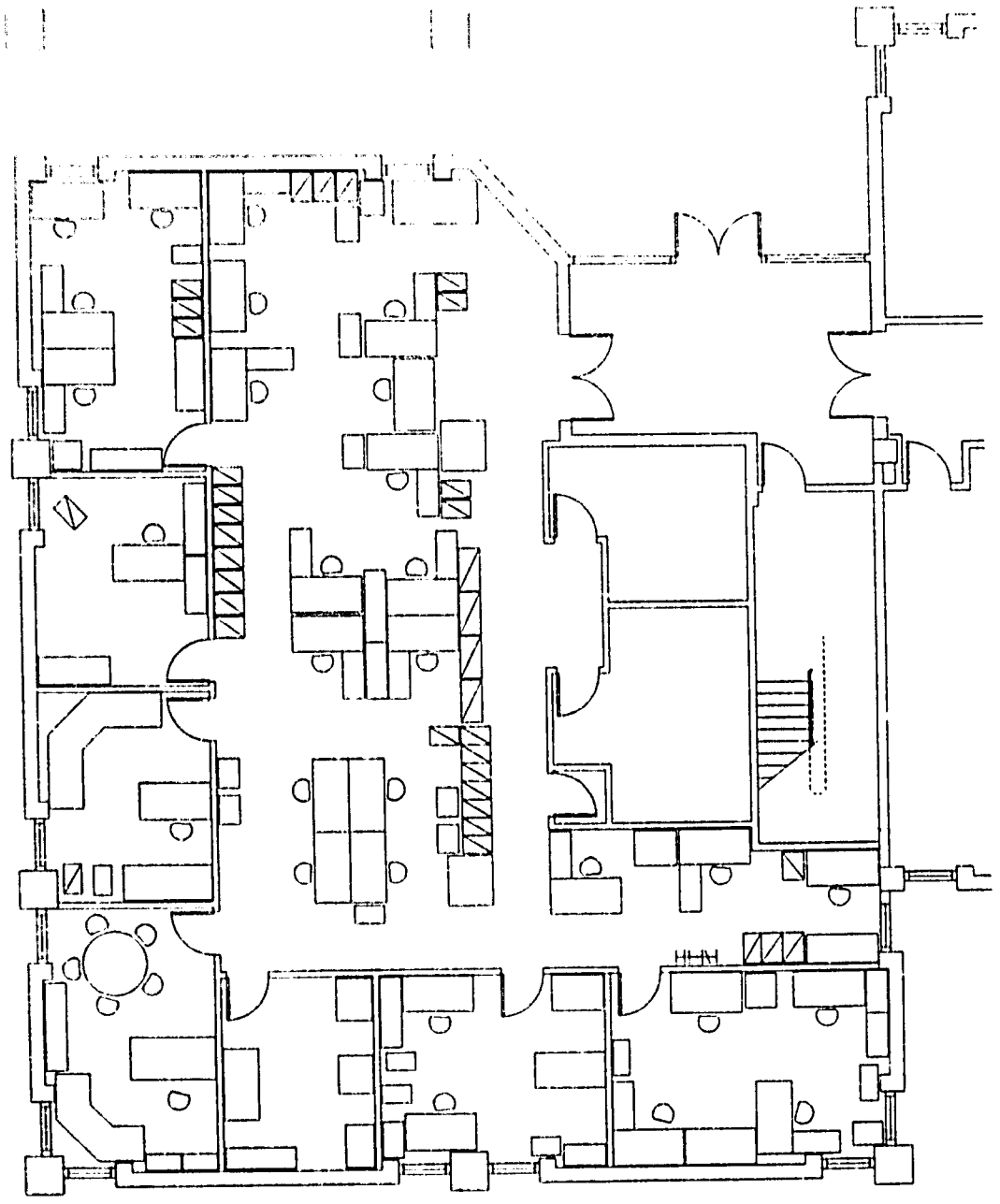


Figure 1. Initial (Time 1) first floor plan, HECSA, part 1.

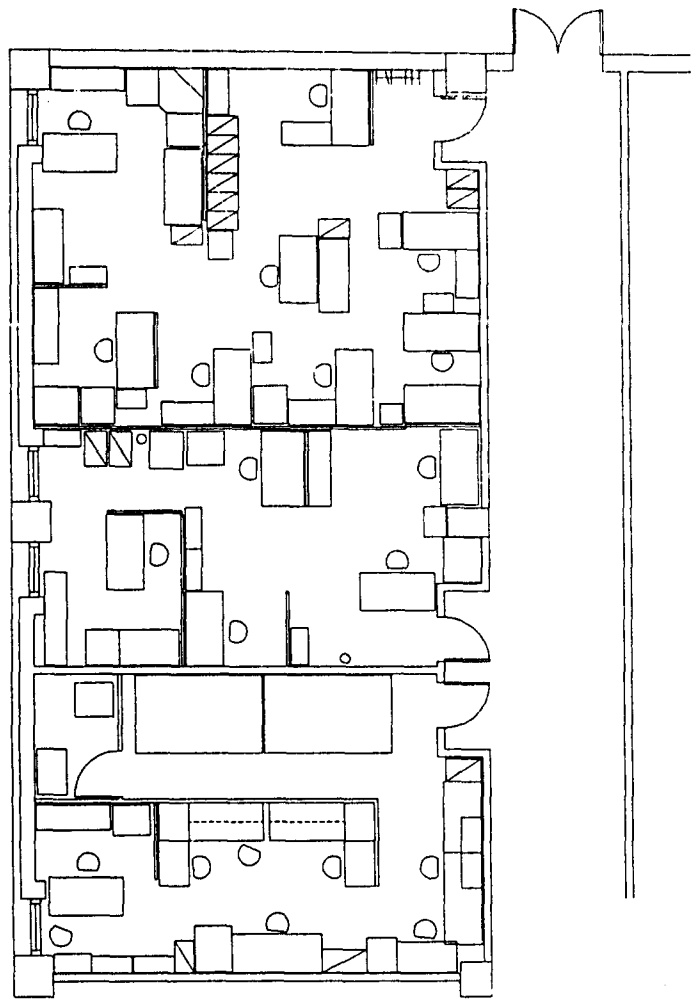


Figure 2. Initial (Time 1) first floor plan, HECSA, part 2.

These problems were seen to be so severe that the office workers found it difficult to perform their daily duties.

Several space arrangements were developed by USACERL personnel and were reviewed with FASO management personnel. Systems furniture was used in the designs because it enabled designers to increase storage and workspace while decreasing the amount of occupied floor space. Additionally, systems furniture would address wire management, acoustics, task lighting, ergonomics, and flexibility for change. Figures 5, 6, and 7 show the plan for the renovated FASO office. This plan was expected to correct virtually all problems, with the possible exception of acoustics.

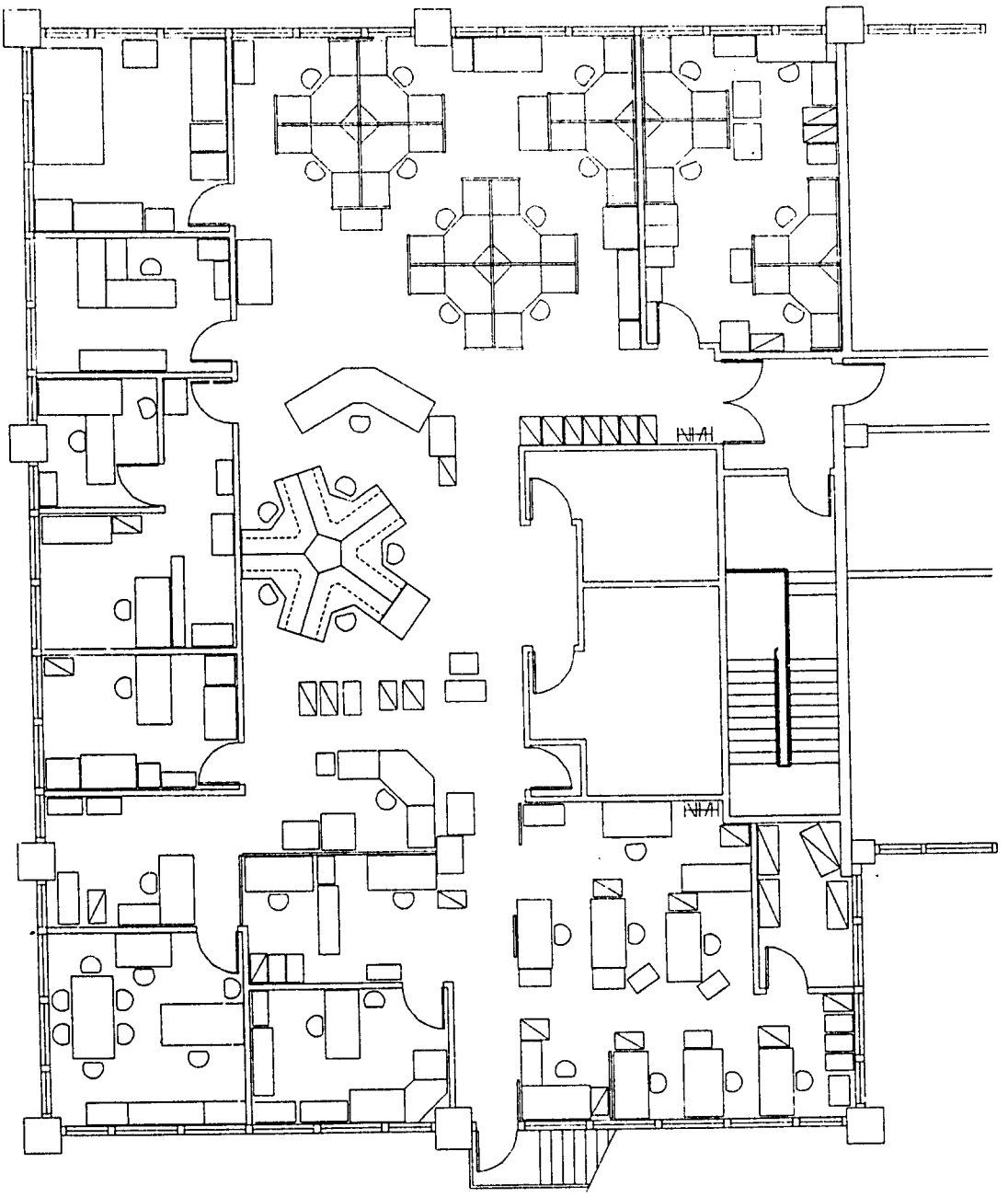


Figure 3. Initial (Time 1) partial second floor plan, HECSA.

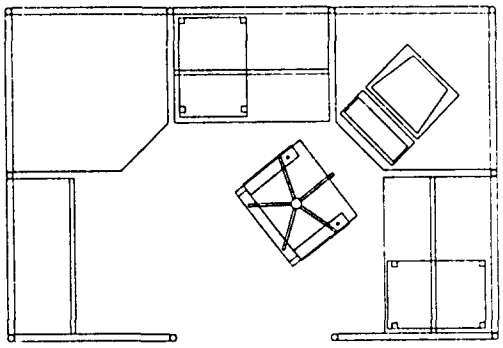
To Meet Your Programming Needs....

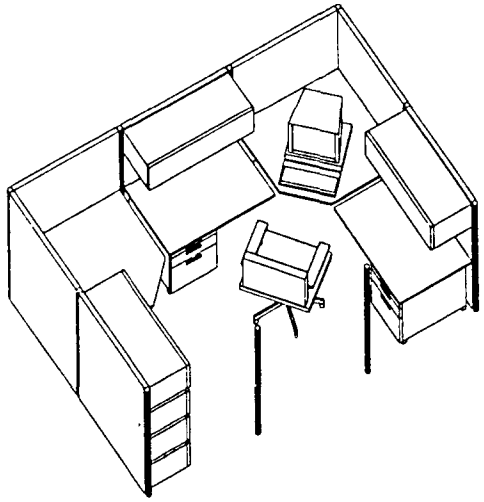
Name:_____ Grade:_____

Section:_____

Prototype Workstation

This prototype workstation is presented as a starting point to determine your workstation needs. The final design of your workstation may change depending on budget and space constraints.





Survey

Above is a prototype for your workstation. To better personalize it for your work needs, please answer the following questions:

Equipment Needs

☐ List the equipment at your workstation and approximate sizes *(i.e., computers, printers, typewriter, etc.)*.

☐ Are you required to share a computer/printer with co-workers? If yes, list equipment, frequency of use, and who it is shared with.

☐ Does your position require you to use common office equipment frequently? If yes, list equipment *(i.e., copier, fax, printers, etc.)*.

Figure 4. Sample of programming questionnaire.

File Needs

☐ List amount and type of current file storage *(i.e., hanging or lateral files, large computer printouts, etc.)*.

- o Is the above file storage adequate? If no, list your needs.

☐ List amount of your current shelf/drawer storage *(i.e., for books, disks, drawings, maps, etc.)*.

- o Is the above shelf/drawer storage adequate? If no, list your needs. Also list sizes of unusual storage items *(i.e., large maps, drawings, equipment)*.

☐ Is your current work surface area adequate? If no, explain *(i.e., work with large drawings, etc.)*.

Space Layout

☐ List 2-3 people that you work closely with daily and need to be located near.

☐ How often does your position require meetings with co-workers?

☐ Are your current Commons Areas adequate? *(i.e., conference, copier, coffee, coat closets, etc.)*.

- o If no, please list needs.

Prototype Workstation

☐ Is the Prototype Workstation, shown in this survey, inadequate for the performance of your job in any way that has not already been addressed in the survey? If yes, please explain.

☐ Additional Comments.

Figure 4. (Continued)

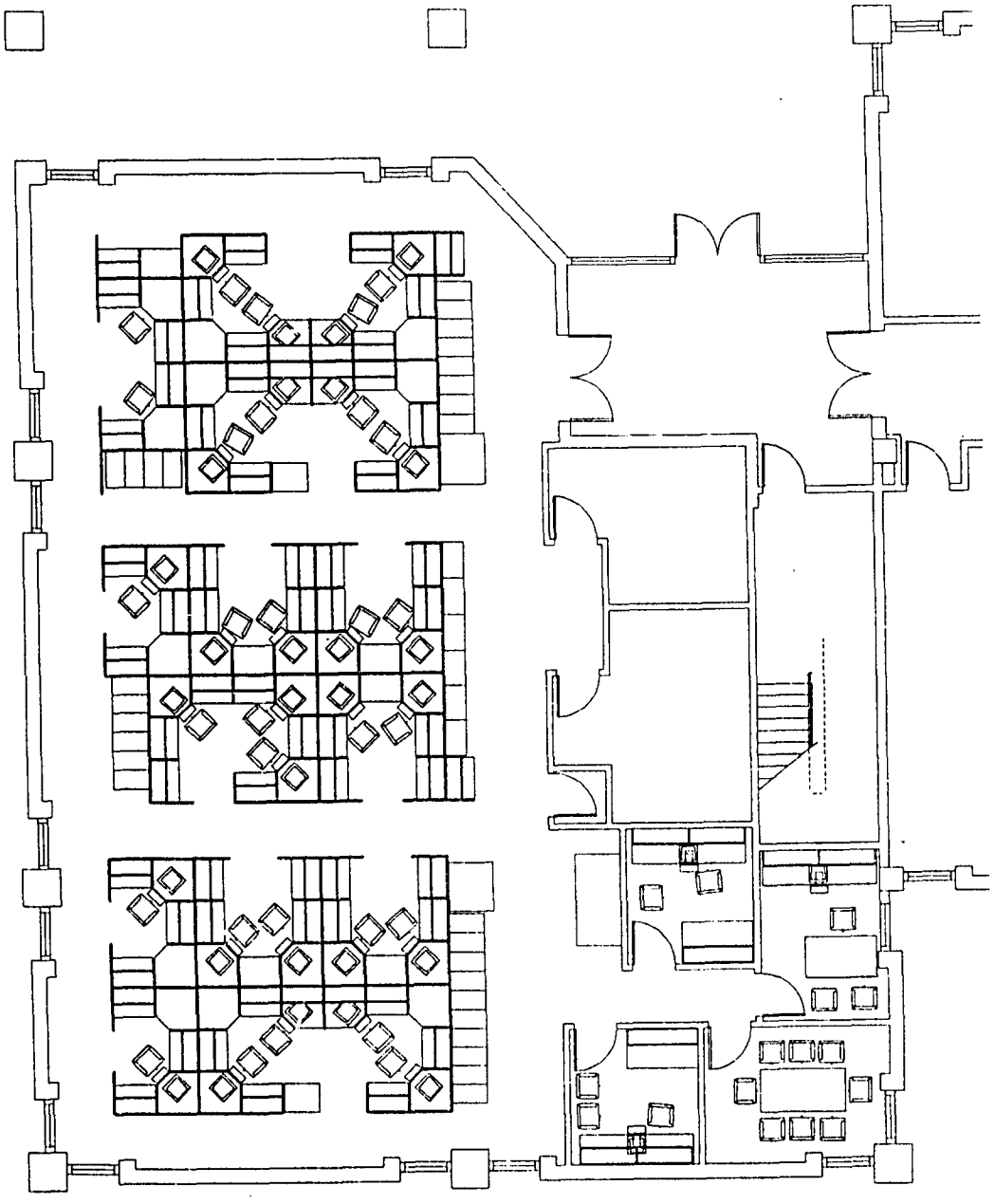


Figure 5. Reconfigured (Time 2) first floor plan, HECSA, part 1.

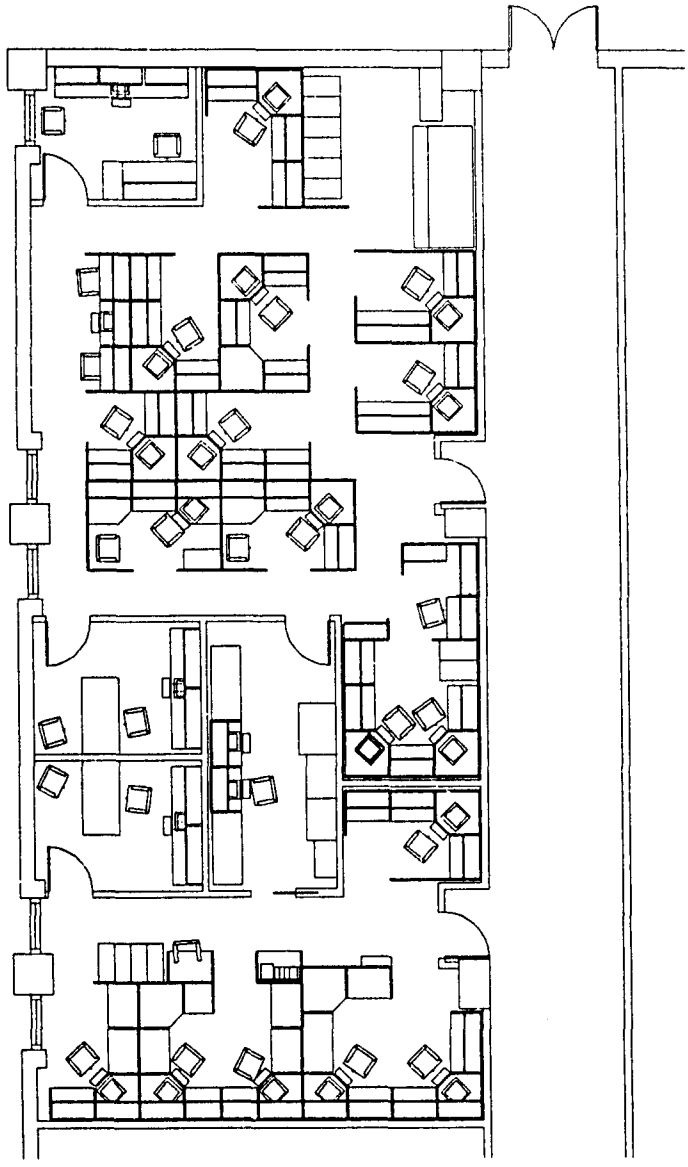


Figure 6. Reconfigured (Time 2) first floor plan, HECSA, part 2.

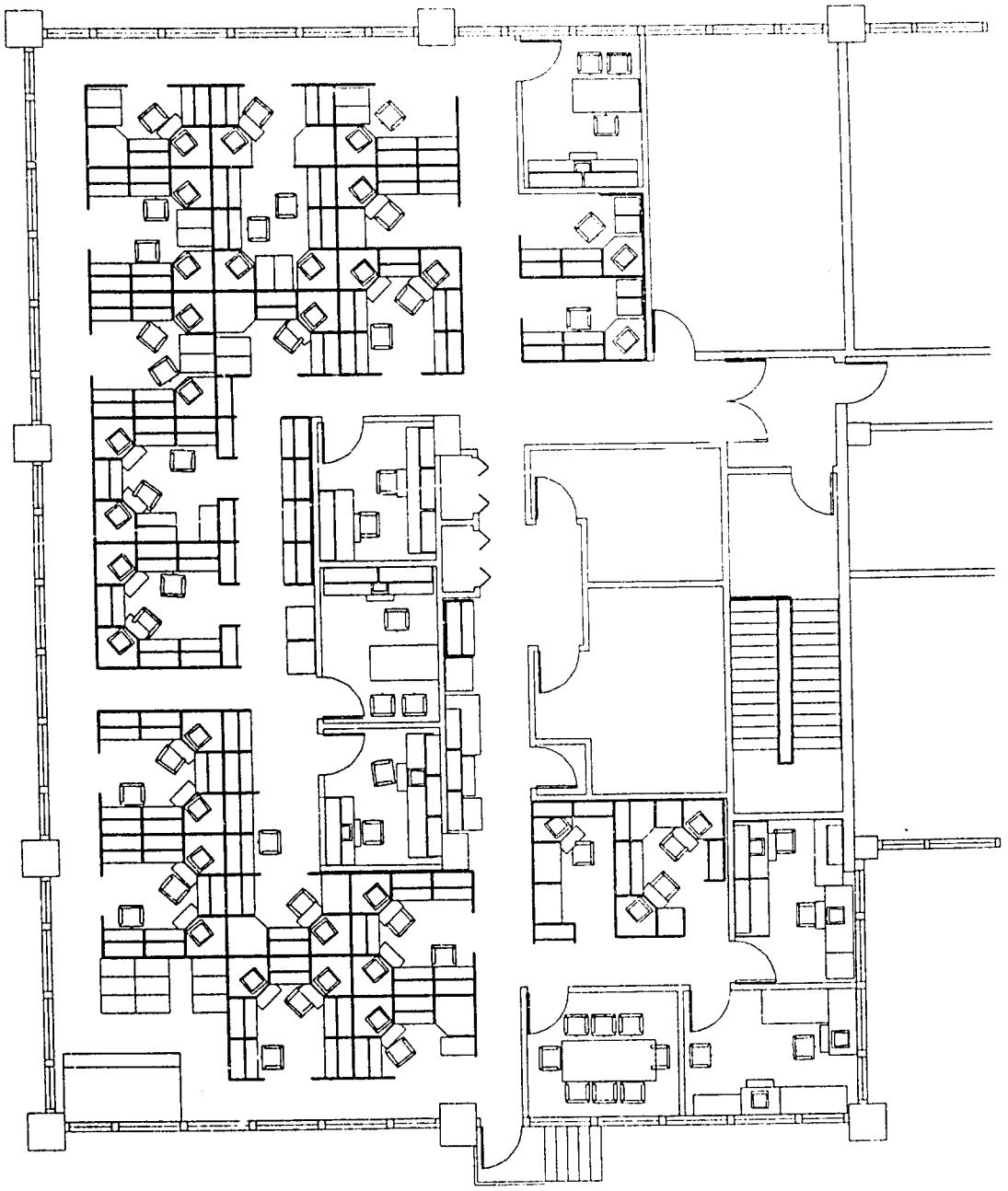


Figure 7. Reconfigured (Time 2) partial second floor plan, HECSA.

Subjects

The subjects of this research were the individuals working in the FASO offices just prior to the renovation (Time 1) and those working in this space 2 months after completion of the renovation (Time 2). Although there were about 100 employees, only 33 of the total respondents were present at both Time 1 and Time 2.

Questionnaire

The questionnaire (see Appendix) measured workers' perceptions of a number of characteristics of the work environment, e.g., lighting, acoustics, temperature, and air quality, as well as the extent to which workers experienced several intermediate outcomes of work (e.g., health and psychological conditions) and more primary outcomes of productivity and work satisfaction.

Procedure

Surveys were distributed to all personnel in the study during the initial visit by USACERL architects on April 16 to 18, 1991. The renovation project was completed by August 3, 1992, and the questionnaire was distributed again in October 1992.

The procedure of obtaining worker perceptions before a change in the environment and obtaining observations after the changes resembles an experiment. However, it is not a true experiment because of the lack of control over all variables that might explain changes in the observations. Campbell and Stanley (1963) have helped identify categories of variables that might be alternative explanations for observed differences. Research that accounts for some of these alternative explanations is referred to as quasi-experimental and can be viewed with more confidence than a simple case study.

3 Results

Preliminary Analyses

The data obtained were placed into three groups: employees who were present only at Time 1, employees who were present only at Time 2, and employees who were present at both times.

First, the responses of those present only at Time 1 were compared with those present at both Time 1 and Time 2. This was accomplished by t-tests of the 150 items of the questionnaire. At the standard level of significance (p=0.05), 5 items in every 100 are expected to be found significantly different by chance. The t-tests found that only seven questions were answered differently by those who left after Time 1 and those who were there at both Time 1 and Time 2. This finding provides no support to the idea that turnover, attrition, etc. are responsible for differences between those who left after Time 1 and those who stayed. This eliminates explanations of the findings based on the idea that those who left after Time 1 were more unhappy with their job, environment, etc. than those who stayed.

Second, the responses of individuals who were there at Time 1 and Time 2 also were compared to the responses of those who were there only at Time 2. Eight questions were answered differently by these two groups. Again, this is no more than what could be expected by chance. New employees cannot be described as different from those who had been there prior to the renovation. Thus, there is no reason to believe that the individuals present at both Time 1 and Time 2 were a unique group. These two comparisons combined eliminate several alternate explanations for possible differences between respondents present at both Time 1 and Time 2, and the results suggest that the changes in the office environment most likely were responsible for the changes in perception.

Analysis Plan

The results of the analysis of the questionnaire data will be presented in two major sections. The first addresses the comparison of responses of only those individuals who completed the questionnaire prior to and after the renovation. The method of analysis was the t-test. Although two averages may be numerically different (e.g., 2.67 and 2.70), the t-test indicates whether the two averages should

be considered as actually being different, i.e., the difference should not be considered to be due to chance alone.

The t-tests provide a probability (p) level that indicates how likely it is the two averages could be different by chance. Traditionally, when p is 0.05 or less, the differences are considered to be real or significant. When p is less than 0.15 but greater than 0.05, the differences are considered to be approaching significance. Significant differences will be noted here because they are the best evidence that the renovation affected the perception and behavior of the employees. Findings that are approaching significance also will be noted because they may be suggestive of further affects of the renovation, particularly if there is a consistent pattern of results.

The second section of the results is from the analysis of the bivariate correlations among questionnaire items, including the examination of the correlation of individual questionnaire items with two general "outcome" measures, workers' satisfaction with working here (V150)* and satisfaction with workstation (V149). More significant relationships between characteristics of the work setting and satisfaction with the workstation were expected than with satisfaction with working here, a more general outcome. More relationships between satisfaction with working here and other more general aspects of the work setting (e.g., management issues and one's own experiences in the work setting) also were expected.

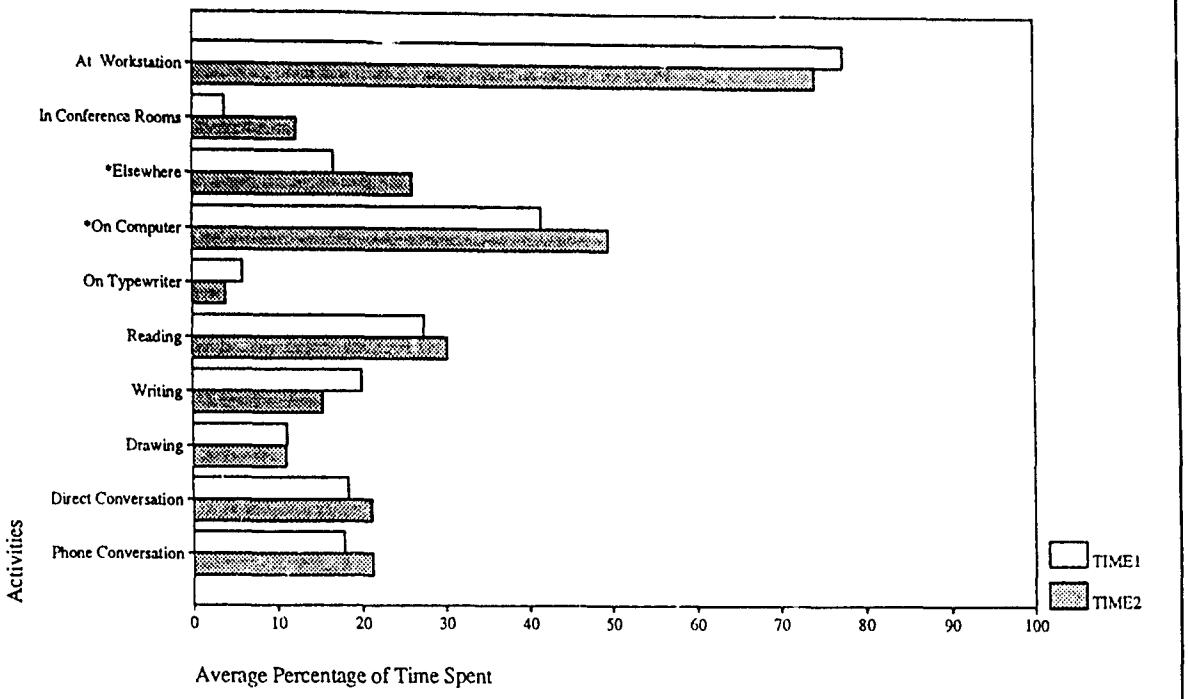
Comparison of Time 1 and Time 2

These analyses compare 33 employees' evaluations of a work environment containing traditional office furniture (Time 1) to the response of the same 33 employees to a renovated environment with systems furniture (Time 2). This comparison was done by using a paired comparison t-test for items in the questionnaire. The results are presented in two major sections: (1) sets of questions that can be thought of as inputs to the office environment system, and (2) sets of questions that can be thought of as outputs.

Inputs of the Workplace

Activities and Experiences. The first section of the questionnaire asked respondents to indicate how much of their workday (Figure 8) or workweek (Figure 9) was spent in certain locations or taken up by certain activities. Because

*Refers to the variable number on the questionnaire in the Appendix.



*Significantly different at 0.05, or loss.

Figure 8. Percent of day spent in workstation activities.

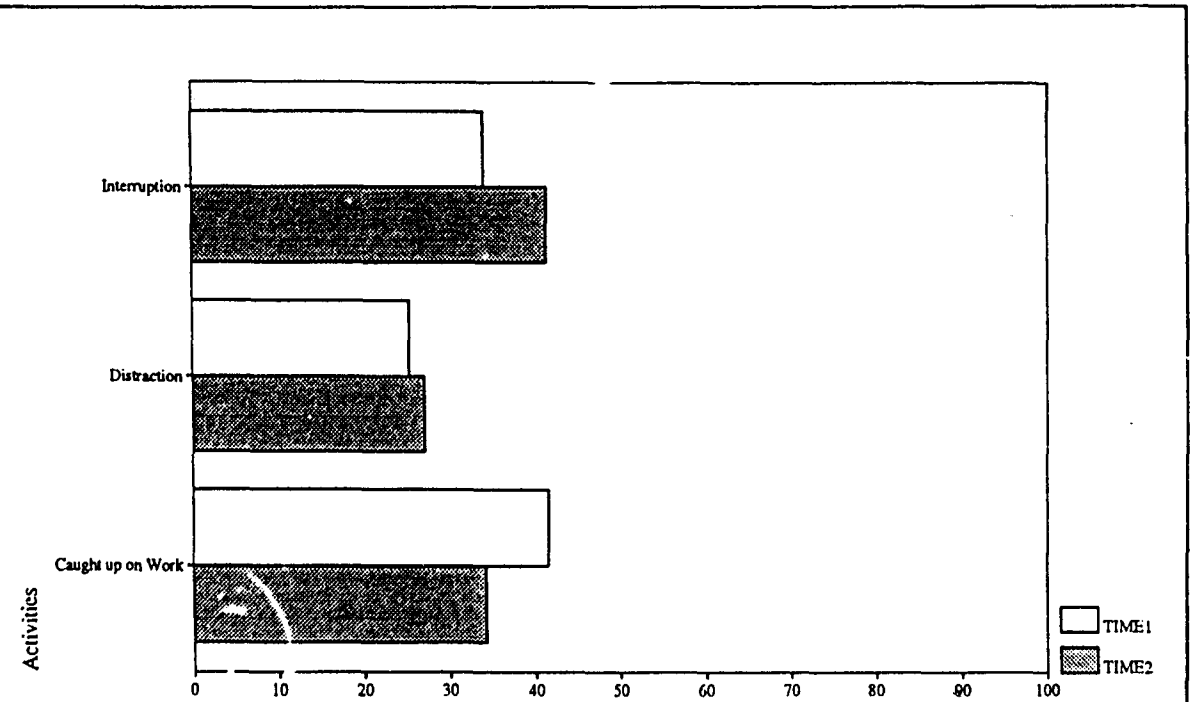


Figure 9. Percent of time spent in a week in workstation activities.

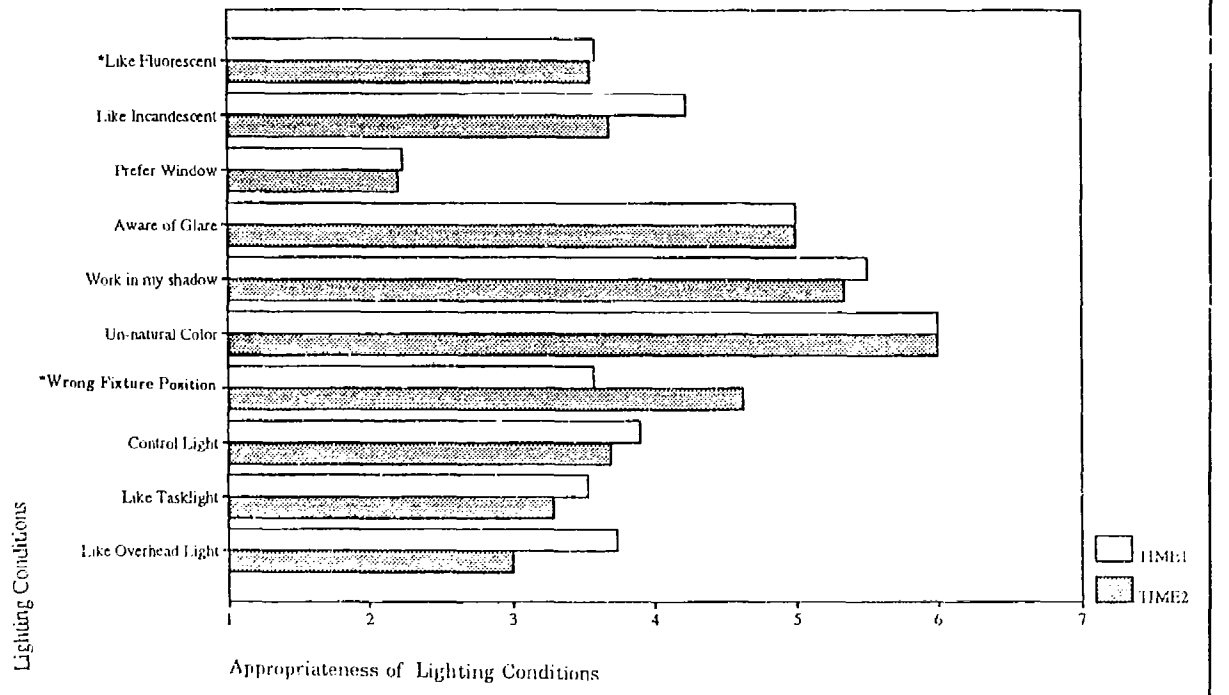
the nature of the individual's job had not changed, few differences were expected between the two times.

Not surprisingly, Figure 8 shows that workers spent most of their time in the building at their workstation. By comparing specific workstation activities, Figure 8 shows how the HECSA workers were spending most of their time. A relatively large amount of time is spent on the computer. However, Figure 8 also shows the important role that conversation plays in the activities of this work environment. Taken together, direct conversation and telephone conversation account for about 40 percent of the office activities.

Figure 8 also shows that there was a statistically significant increase in the amount of time using a computer, as well as a significant increase in the amount of time spent in "other locations in your building." Several explanations can be put forward for the increase in computer use, including an increase in access to computers or an increase in the number of computers after the renovation. However, no computers were added after the renovation nor was there a change in access. The difference in reported time on the computers also could have resulted from a change in work flow to require more computer contact, but no information is available on this possibility. Another explanation would give credit for increased computer use to the renovation; the new workstations provide privacy, control, and other attributes that allow individuals to spend more time on their computer tasks, i.e., this change in activity may be an indication of increased productivity. Currently there is insufficient information to explain the increase in computer use.

Lighting Conditions at the Workstation. The first three items in Figure 10 represent preferences for incandescent, fluorescent, and natural light. Although some designers have argued for windowless office environments, the comparison of these three items suggests that windowless designs generally should not be pursued. At Time 2, the t-test indicates that people were more favorable about incandescent lighting.

Although there were no statistically significant differences from Time 1 to Time 2 for having "sufficient control of lighting" and being "satisfied with the task lighting," the direction of responses were in the hypothesized direction, i.e., responses were more positive after the changes. Comments written in response to the question, "What are the good things about the lighting at your workstation?" also indicated the importance of control of lighting, e.g., "I have control of undershelf lights" and "ability to control amount of light."



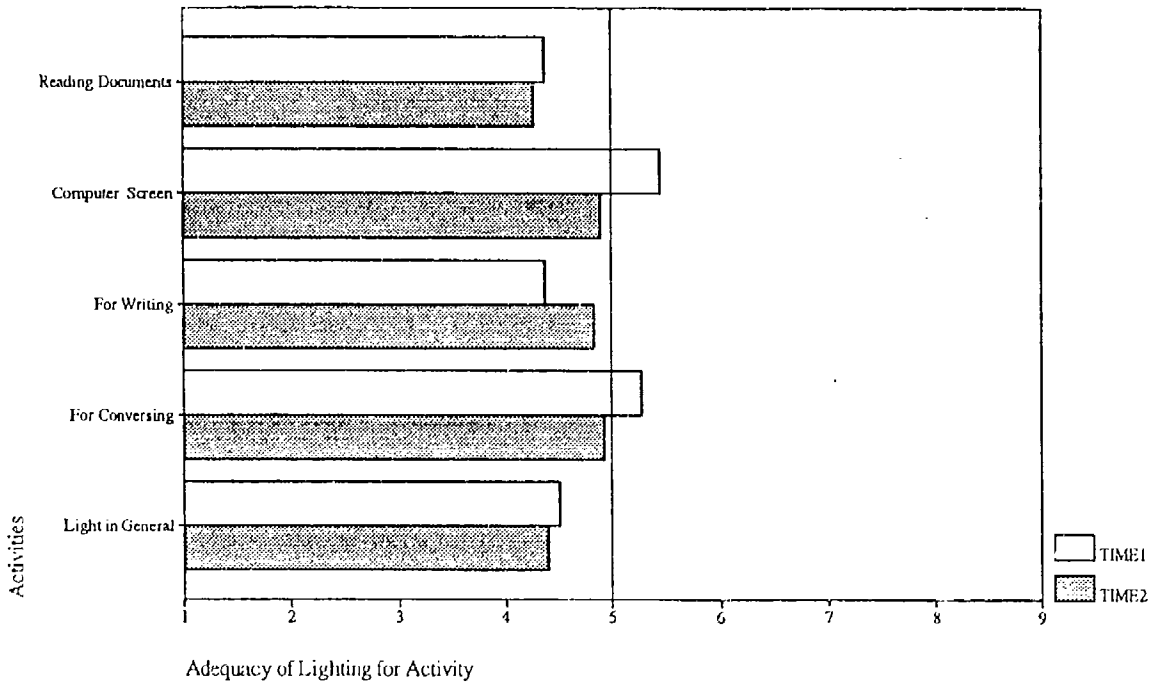
1=Always, 4=Sometimes, 7=Never. *Significantly different at 0.05, or less.

Figure 10. Workstation environment. Appropriateness of lighting conditions.

Figure 10 does not show a statistically significant difference in glare between Time 1 and Time 2. However, that does not mean that glare is not an issue--only that there was no change in its perception between Time 1 and Time 2. Comments to the open-ended question, "What are the bad things about the lighting at your workstation?" suggest that glare is an important problem for some people. Among the comments made by 32 respondents, the most frequent comment concerned glare on the computer screen, e.g., "overhead lights put glare on the screen" and "overhead lights are behind me at my computer."

The open-ended responses also showed a concern for the pattern of lighting in the office with comments like "not evenly distributed" and "not evenly lit." This may indicate that at least some of the occupants of this office are using a brightly lit and evenly lit ideal as their model of comparison. In fact, this was the model of lighting designs in past decades. Today's designs tend to be more energy conscientious, directional, and user controlled. It may take time for workers to lose this expectation for the way their work environment is lit.

The adequacy of light levels for various tasks are shown in Figure 11. Although there were no significant differences at the 0.05 level, there were, again, responses that approached significance (p levels from 0.06 to 0.11 for three items). At Time 2, lighting conditions for reading the computer screen, for writing, and for

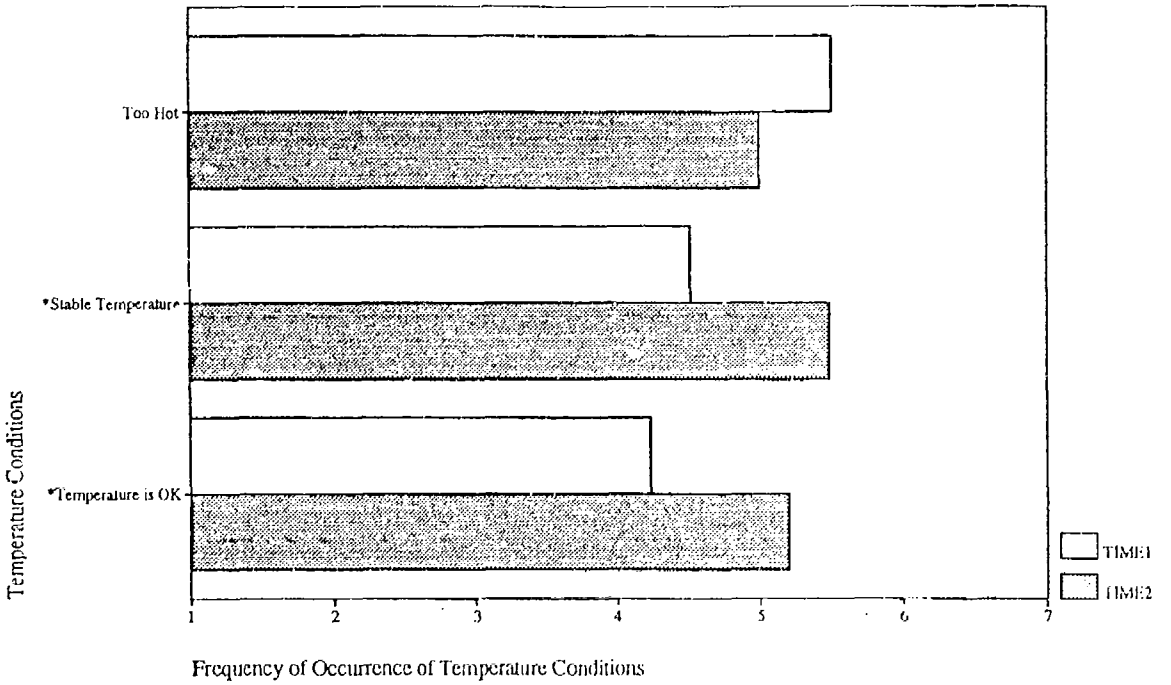


1=Too Dim, 5=Just Right, 9=Too Bright.

Figure 11. Workstation environment. Adequacy of lighting conditions.

conversing with others were more positive (closer to "just right" on the scales) than at Time 1. This pattern suggests that the lighting changes were generally positive and effective. In fact, many (10 of 28 responding) of the open-ended comments describing "good things about the lighting" focused on the adequacy of the light level with comments such as "well lit" and "sufficient lighting for all purposes." Only four individuals indicated in their open-ended responses that their workstation was "too dim" or "too dark."

Temperature and Related Conditions at the Workstation. The frequency with which certain temperature conditions at the workstation occurred is shown in Figure 12. In contrast to expectations, perceptions of the temperature and related conditions worsened at Time 2. People were less satisfied with the workstation temperature and felt that stable temperature conditions occurred less often. This dissatisfaction with the thermal conditions of the environment is further highlighted in the open-ended comments. When asked at Time 2, "What are the good things about the temperature conditions at your workstation?" 57 percent responded with negative comments, e.g., "nothing," "there aren't any," and "if I ever want to experience the arctic I only have to come to work."



1=Always, 4=Sometimes, 7=Never. *Significantly different at 0.05, or less.

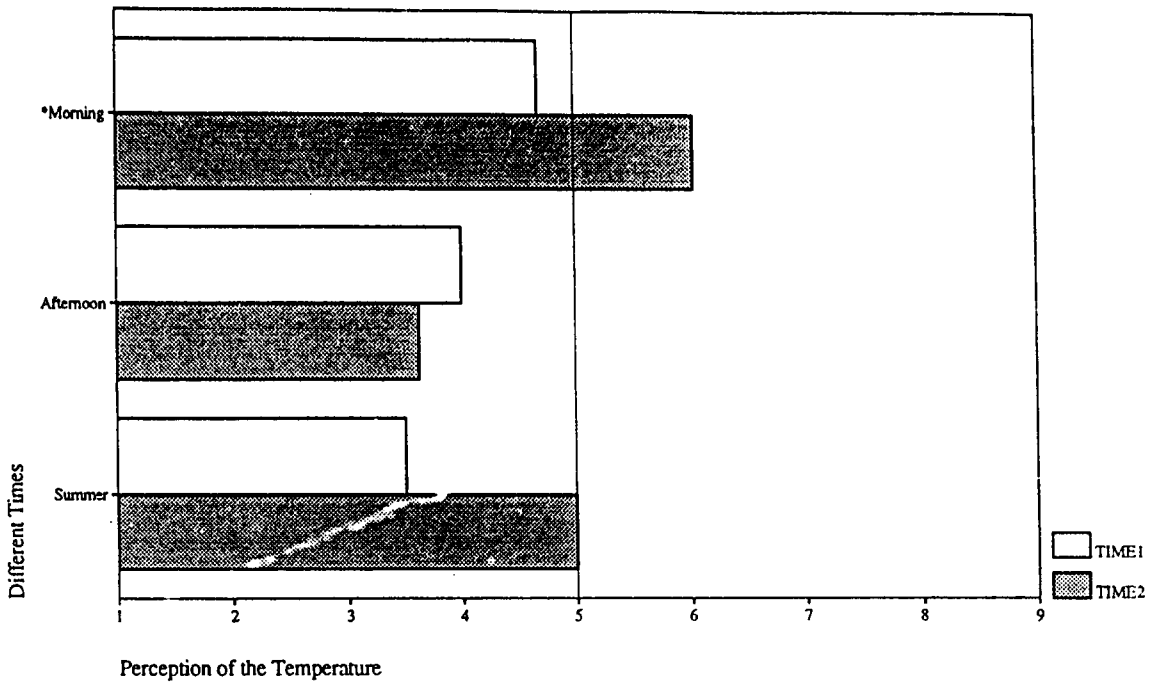
Figure 12. Workstation temperature conditions.

The problem of temperature stability seen in Figure 12 also is emphasized in the open-ended responses. When asked "What are the bad things about temperature conditions at your workstation?" 35 percent made comments indicating that temperature conditions generally were not stable, e.g., "too hot in the afternoon," "you either freeze or sweat," and "unpredictable temperature."

In spite of these negative evaluations, Figure 13 shows that perceptions of summer workstation temperatures have tended to improve, with the average response being "just right." The difference between Time 1 and Time 2 responses to this item approached statistical significance (p=0.07).

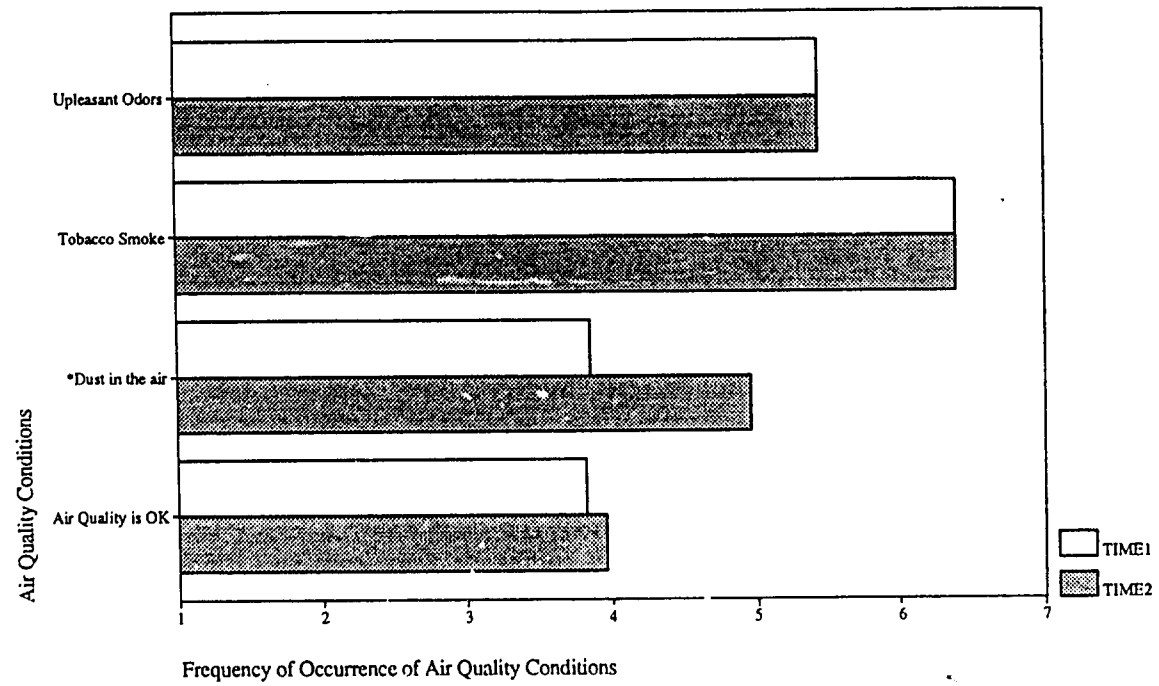
Figure 13 also shows that perceived morning workstation temperatures were significantly worse after the change, in that they were judged to be too cool. Afternoon temperatures were still felt to be somewhat warmer than comfortable. Again, the open-ended comments reinforce each of these ideas: the temperature is too cool in the morning, too hot in the afternoon, and not stable during the day.

Workstation Air Quality. How frequently individuals experience three air quality conditions at the workstation is shown in Figure 14, as well as an overall evaluation of air quality. In general, the figure shows that the average perception of unpleasant odors and tobacco smoke did not vary between Time 1 or Time 2.



1=Too Hot, 5=Just Right, 9=Too Cold. *Significantly different at 0.05, or less.

Figure 13. Specific temperature conditions.



1=Always, 4=Sometimes, 7=Never. *Significantly different at 0.05, or less.

Figure 14. Workstation air quality.

It also shows that these two problems were infrequently experienced. In fact, about 40 percent of the respondents at Time 2 said that they never were aware of unpleasant odors, and over 75 percent said that they never were aware of smoke.

There was significantly less dust in the air after remodeling (Time 2). However, there was no significant change in satisfaction with the air quality at the workstation. It remained at an intermediate level.

Summer perceptions of air quality are shown in Figure 15. There were no significant differences between Time 1 and Time 2 for any of the evaluations. In general, workstations were felt to be somewhat stuffy in summer and more on the stale side.

Acoustics. The frequency with which people believe various acoustical conditions occur in their workstation is shown in Figure 16. Two specific experiences changed between Time 1 and Time 2. The perception of hearing noise from office copiers increased and the perception of hearing typewriters and printers decreased. Still, when asked in an open-ended question to describe specific problems with noise or sound, the most frequent response indicated printers to be

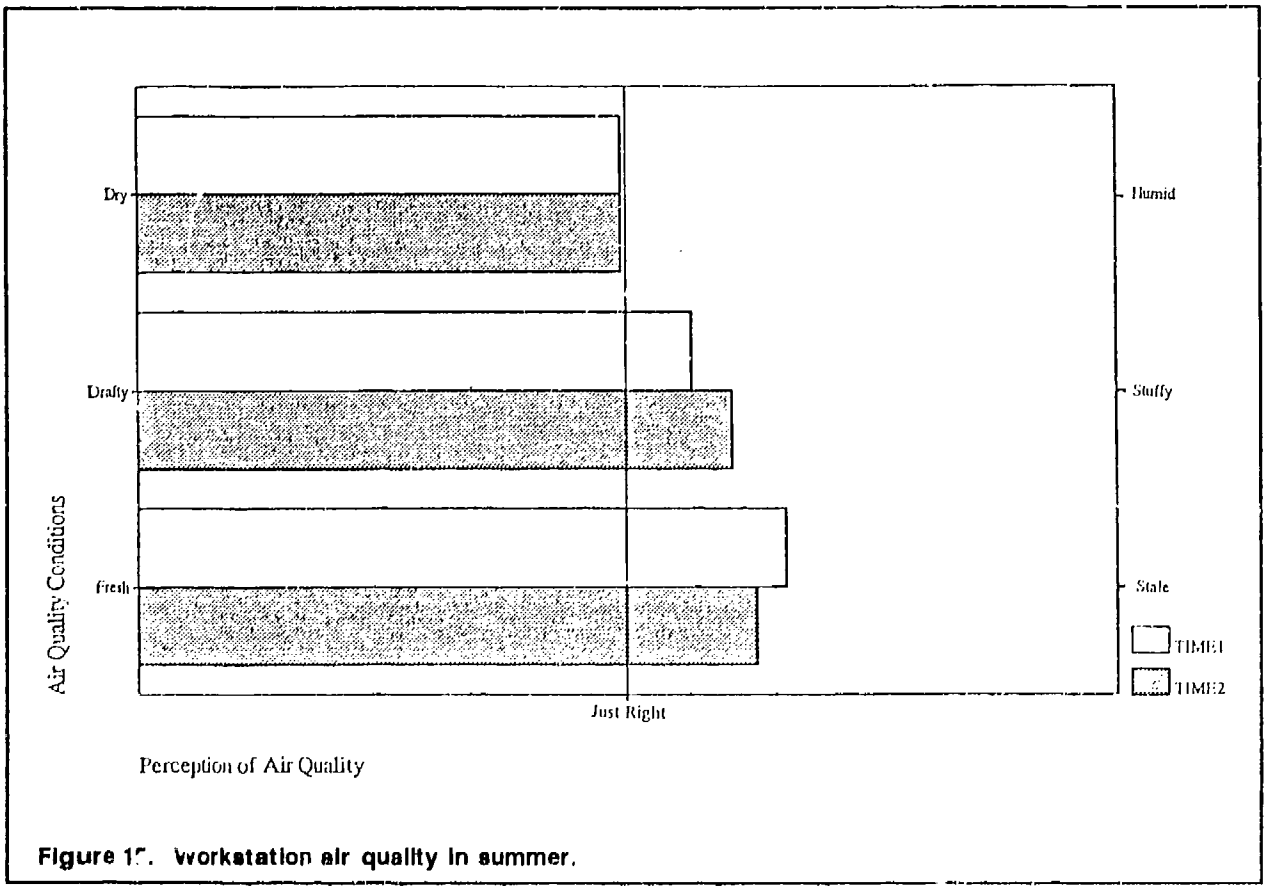


Figure 15. Workstation air quality in summer.

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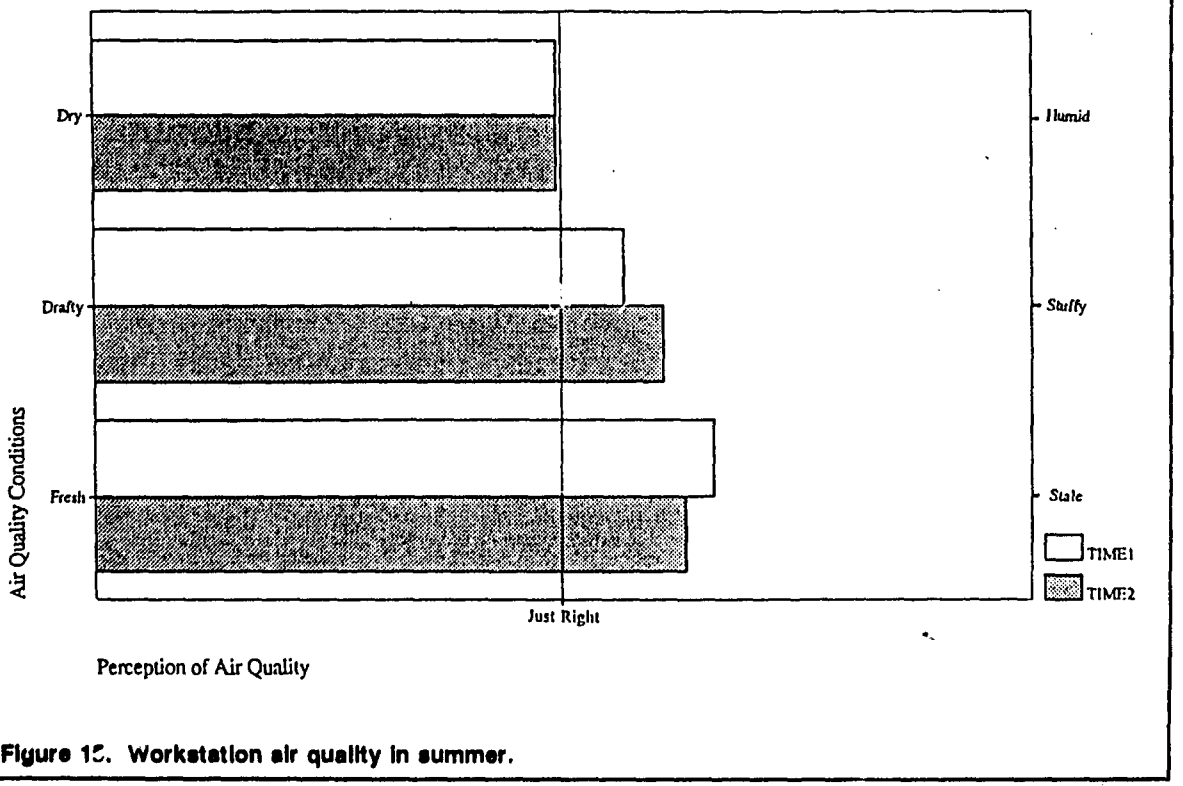
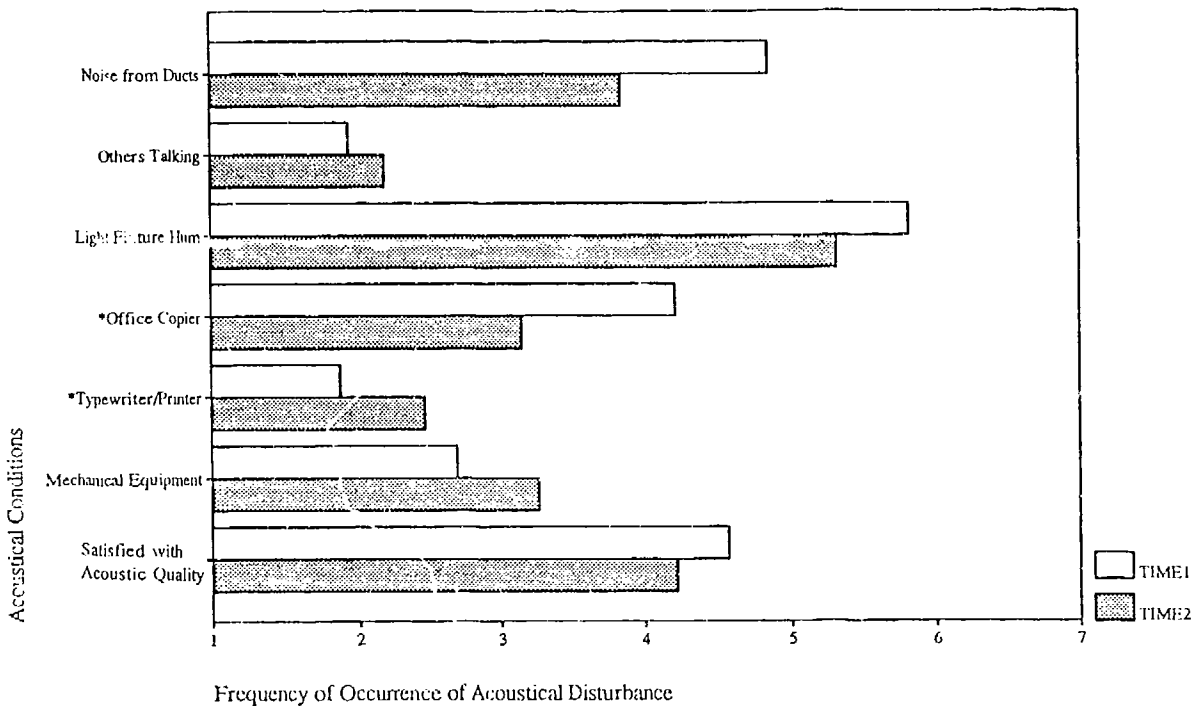


Figure 15. Workstation air quality in summer.

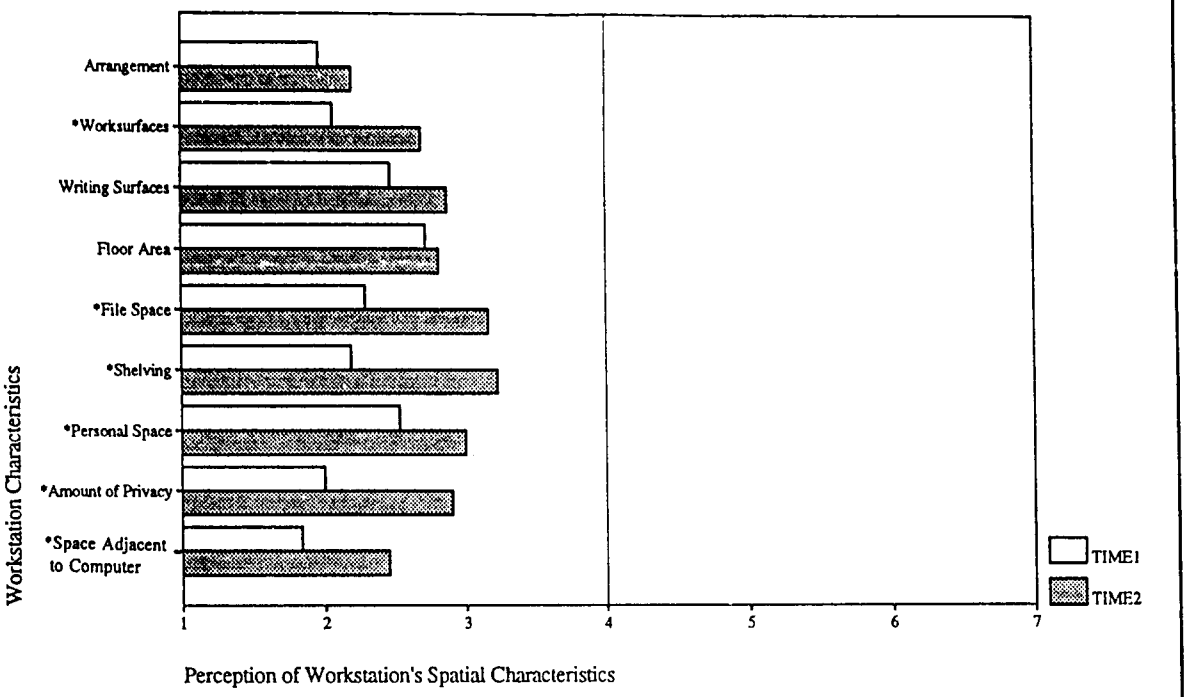


1=Always, 4=Sometimes, 7=Never. *Significantly different at 0.05, or less.

Figure 16. Workstation acoustics.

the problem; over 50 percent of the 34 individuals who provided an open-ended response listed something about printers. The next most frequently mentioned source of noise was conversations or other people talking. There is a tendency to hear noise from the air ducts more at Time 2 than at Time 1 (p=0.07) and to hear more light fixture hum at Time 2 (p=0.15). The level of satisfaction with the acoustic quality of the workstation is not significantly different between Time 1 or Time 2. When asked to indicate on the scaled item whether the office was too quiet or too noisy, respondents showed no difference between Time 1 and Time 2. In both cases, the average response was on the noisy side of the scale.

Workstation Characteristics. Because the design programming efforts at Time 1 (see Figure 4) and the subsequent design solution focused on spatial needs of each worker, one of the primary expectations of this research was that people would be especially responsive to specific spatial changes in the workstation setting. Figure 17 compares evaluations of various spatial characteristics of the workstations. Of the nine items, six showed significant perceptions of improvement at Time 2, as expected. The amount of work surface, file space, and shelving and the space for typing had average responses that were much closer to "just right" at Time 2 than Time 1. The amount of space for personal items as well as the amount of privacy provided by the workspace also were felt to be better at Time 2. A seventh item,



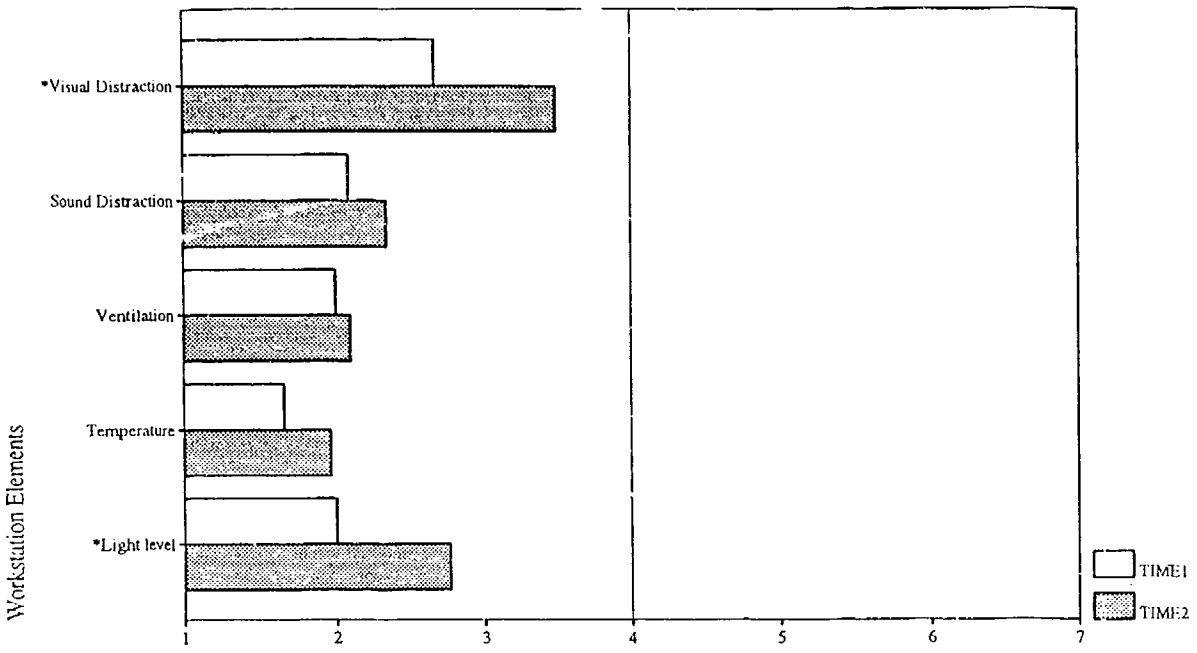
1=Too Little, 4=Just Right, 7=Too Much. *Significantly different at 0.05, or less.

Figure 17. Workstation spatial characteristics.

adequacy of the amount of writing surface space, approached significance (p=0.08), showing an improved perception at Time 2 also. Thus, workers perceived a change in specific spatial characteristics of their workstation, and it was positive. This set of changes in the perceptions of the office environment between Time 1 and Time 2 is a strong indicator of the success of the renovation of the HECSA office environment. People perceived an improved work environment in terms of its spatial characteristics.

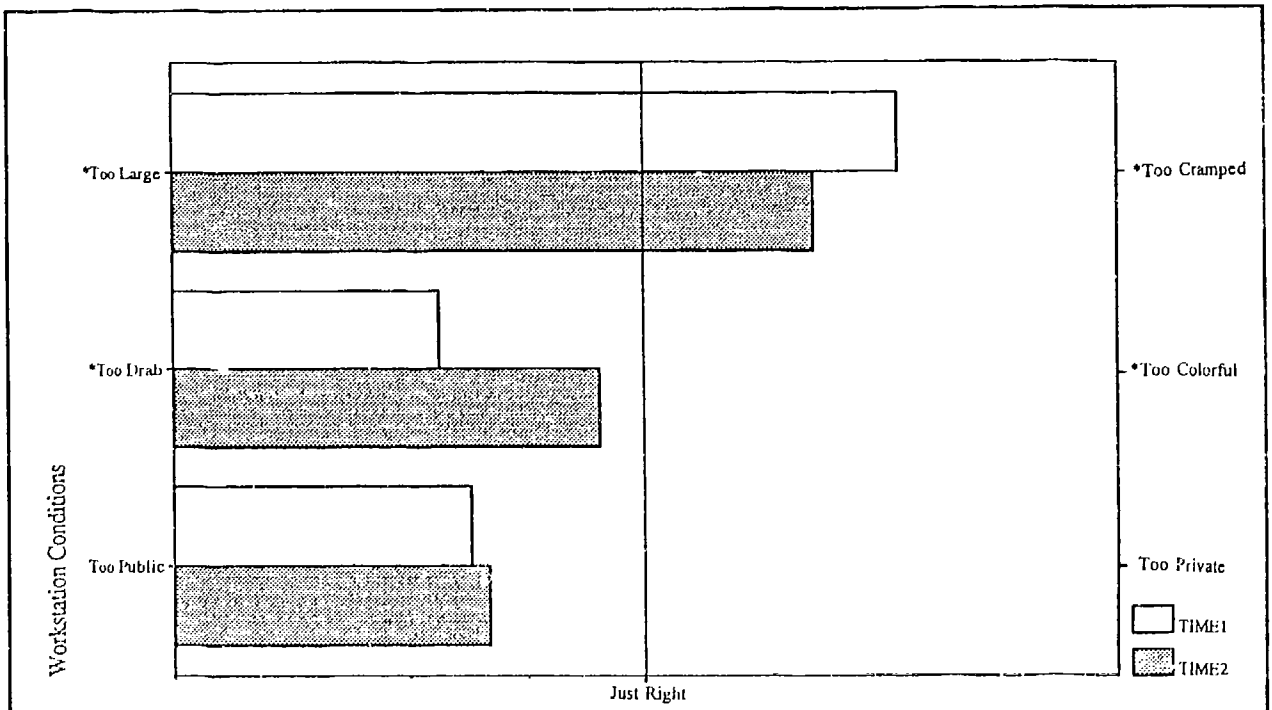
A set of questions answered by the workers concerned their ability to control aspects of their work environment. Figure 18 shows the changes in average responses for five questions related to control. Two showed significant improvement at Time 2; provisions for controlling visual distractions and light levels were perceived to be better. This seems to be an additional indicator of the success of the renovation.

Additional overall evaluations of the workstation are shown in Figure 19. Significant improvements (ratings of "just right") were seen for both the size of the space and colorfulness of the workspace at Time 2. Still, there was an overall feeling that workstations were "too public" at both Time 1 and Time 2.



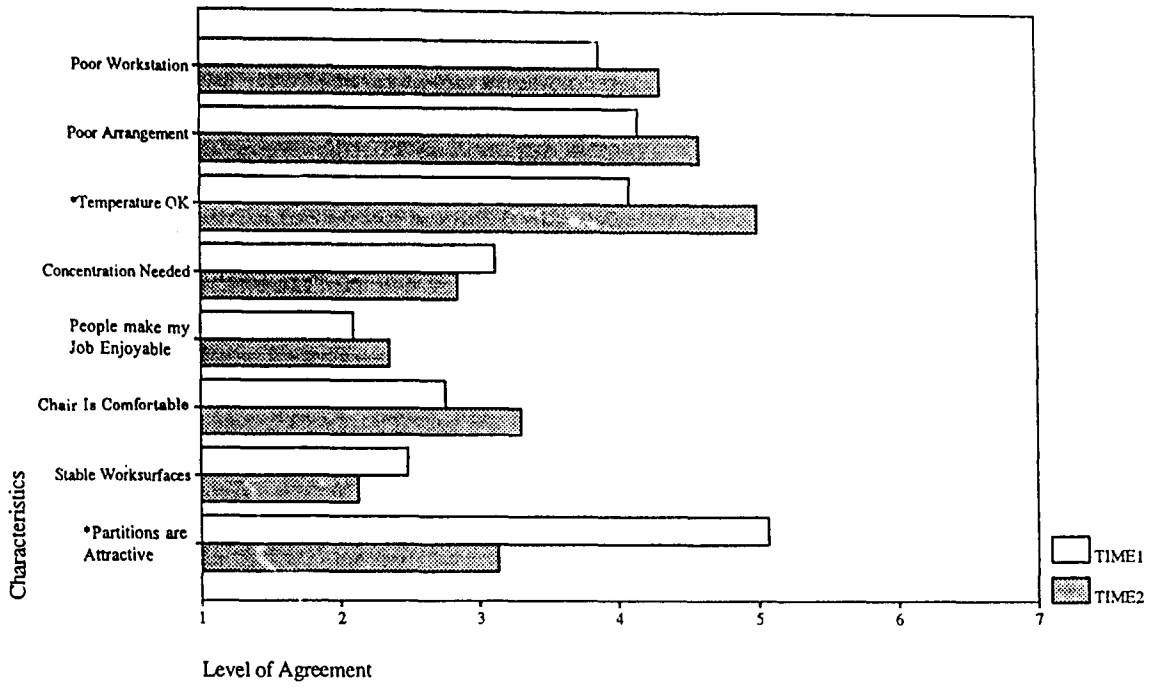
1=Too Little, 4=Just Right, 7=Too Much. *Significantly different at 0.05, or less.

Figure 18. Workstation control.



*Significantly different at 0.05, or less.

Figure 19. General workstation perceptions.



1=Strongly Agree, 7=Strongly Disagree. *Significantly different at 0.05, or less.

Figure 20. Perceptions of workstation characteristics.

Figure 20 shows the level of agreement or disagreement with a number of statements about the workstation setting. Most deal with the physical aspect, although two address the job itself. Results are somewhat mixed here. The two significantly different findings showed that partitions around the workstation were seen as more attractive at Time 2; however, people were less satisfied with the temperature of their workstation (this was a second measure of temperature satisfaction intended to give an indication of the reliability of the responses in terms of internal consistency). Several other items approached significance. Two were positive: workstation arrangement of work surfaces (p=0.08) and the stability of the work surfaces (p=0.11) appeared to be better at Time 2. However, the comfort of their workstation chair was felt to be less (p=0.08) at Time 2. An interesting note is that new chairs were obtained between Time 1 and Time 2; however, they were selected independently from the USACERL Baltimore Corps of Engineers interior design activities that developed the overall renovation proposal.

Outcomes of the Workplace

The previous discussion showed that the renovation of the HECSA environment affected worker perception of several aspects of the workplace, e.g., temperature.

This section addresses issues that can be described as the outcomes of the work environment and include individual outcomes as well as work-related outcomes.

Frequency of Workstation Behaviors. There were no significant differences from Time 1 to Time 2 in terms of the frequency with which people made adjustments to various parts of their workstation (Figure 21). Two items approached significance. Adjustment of the thermostat occurred slightly more at Time 2 (p=0.08), but still occurs rarely. This is in spite of the presence of thermostats in some workspaces and the previously reported dissatisfaction with temperature. Also people reported a tendency to delay a task to avoid being interrupted by others more at Time 2 (p=0.08) than at Time 1. Note that all of these behaviors were infrequent at both times; frequent occurrences would indicate definite problems with the workstation.

Work Experiences. People may feel numerous types of experiences (physical or emotional) while they are at work. Figures 22 and 23 present some interesting and unexpected results. Although there were no significant differences between Time 1 and Time 2 in terms of "emotional" experiences (Figure 22), there were significant differences in the frequency of occurrence of a number of "physical" conditions (Figure 23); and these all indicated a greater occurrence at Time 2. That is, there were more headaches, nausea, and soreness in the wrists and arms

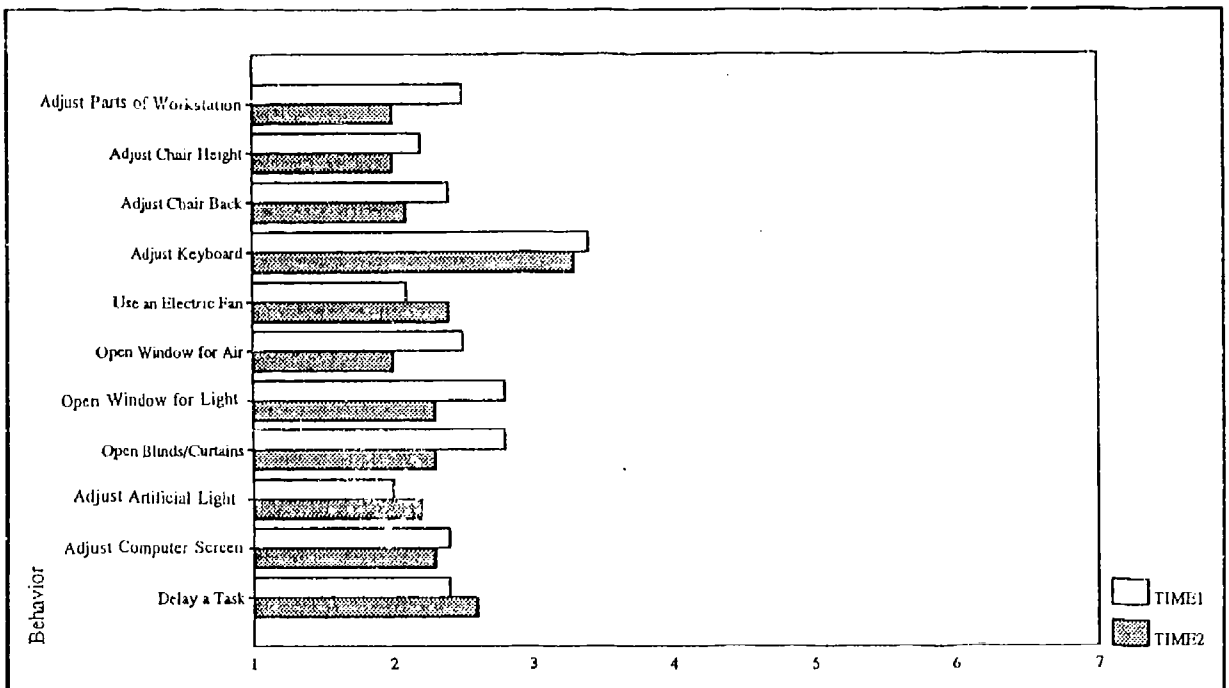
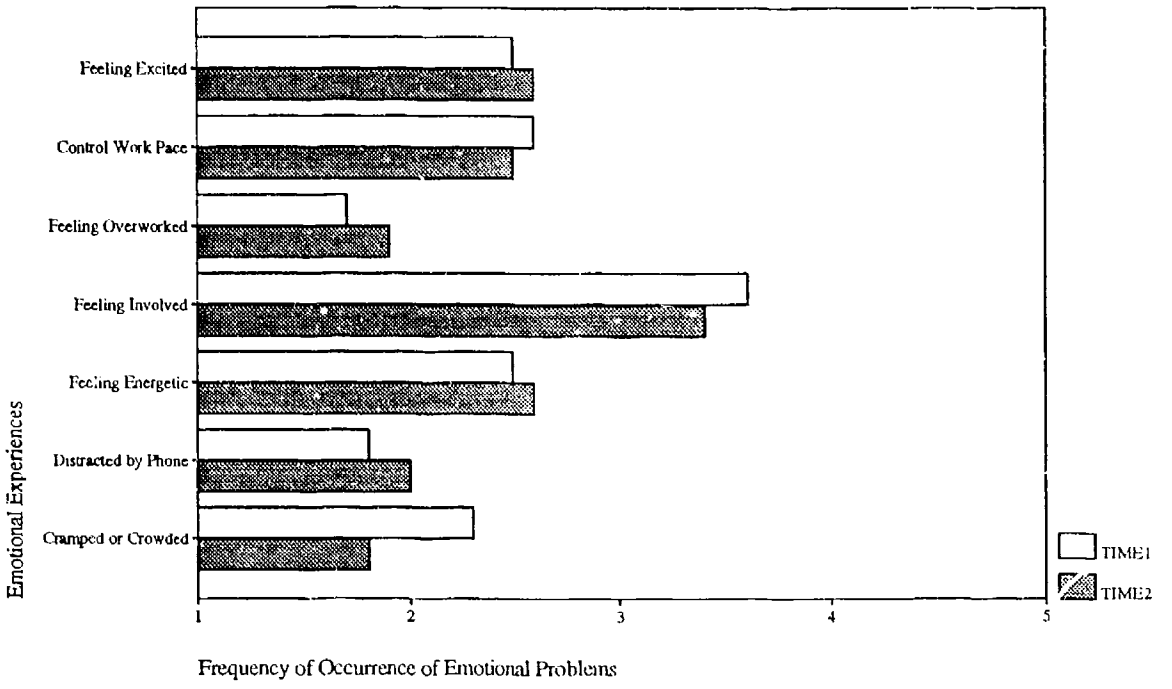
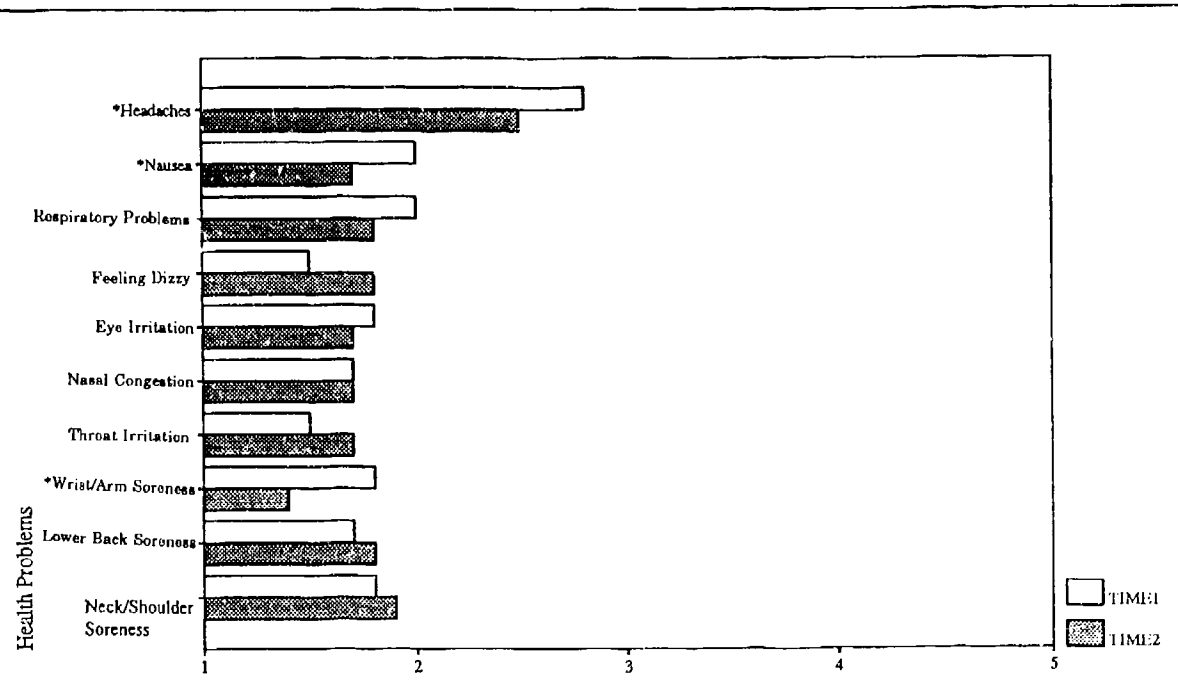


Figure 21. Workstation behaviors.



1=Never, 3=Sometimes, 5=Always. Inadequately trained was not shown on this graph because the responses are less than 1.

Figure 22. Emotional experiences.

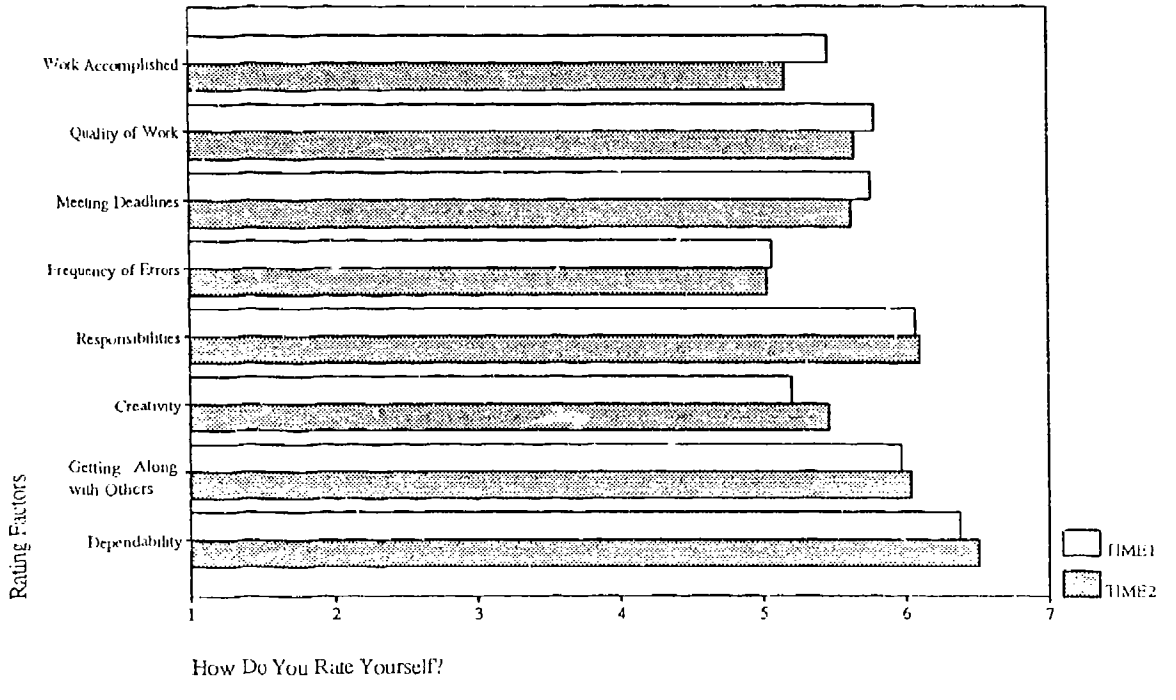


1=Never, 3=Sometimes, 5=Always. *Significantly different at 0.05, or less. Contact lens irritation was not shown on this graph because the responses are less than 1.

Figure 23. Physical work experiences.

reported at Time 2. Two other physical conditions approached significance. The frequency of respiratory problems (p=0.13) and of throat irritation (p=0.07) appeared to be more frequent at Time 2. This increase in physical problems could be a variation of the "sick building" phenomenon. Because new equipment, new chairs, a modified HVAC system, and/or the application of new paint were changes made between Time 1 and Time 2, these items may have been emitting nonodiferous fumes that influenced some of the individual physical conditions. Wrist soreness also could indicate improper adjustment of workstation equipment at Time 2. These results indicate a clear need for another evaluation of the work environment at a later time.

Evaluations of Own Performance and Others' Performance. Eight items on the questionnaire addressed the acceptability of various types of work performance. Respondents were asked to rate themselves (Figure 24) and their co-workers (Figure 25). Self-ratings generally were somewhat higher than co-worker ratings, but the major issue was whether or not there was a change in perceptions from Time 1 to Time 2. Although there were no statistically significant differences, there were three instances in which significance was approached. For rating one's own performance (Figure 24), people tended to report less work accomplished (p=0.09) but greater creativity (p=0.08) at Time 2 than at Time 1. Perhaps people had not yet had time to "settle in" and feel as if they were accomplishing as much



1=Absolutely not acceptable, 7=Absolutely idea..

Figure 24. Self ratings on doing the work.

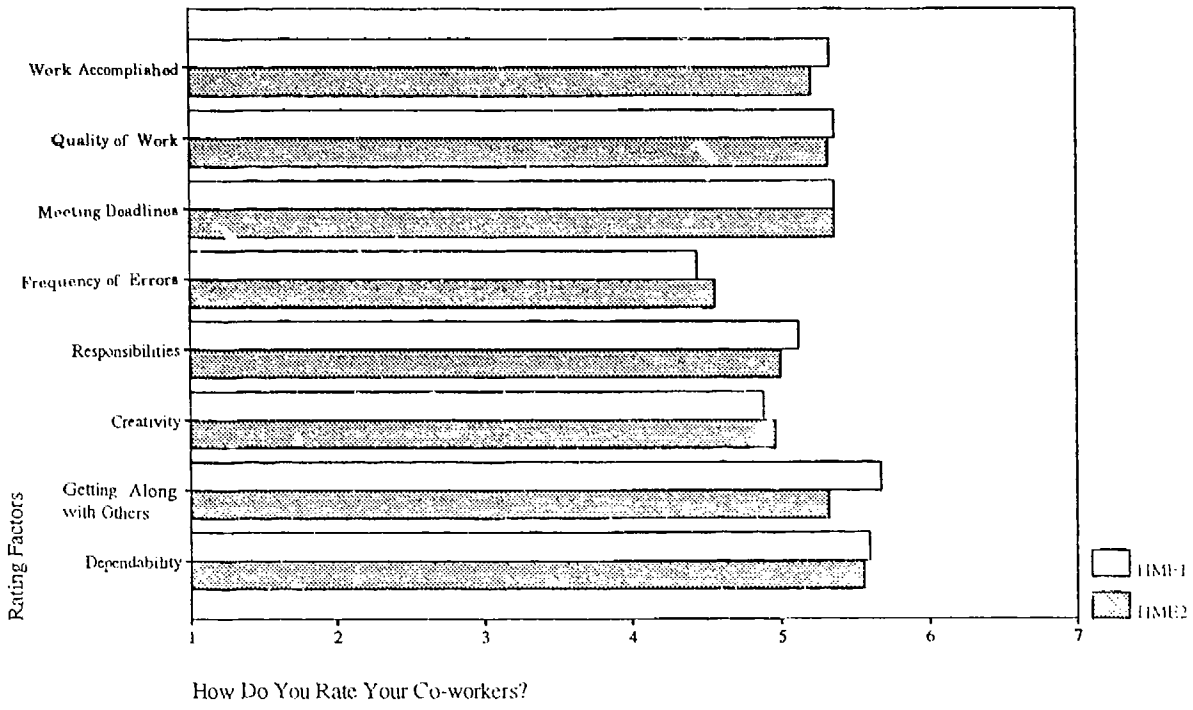


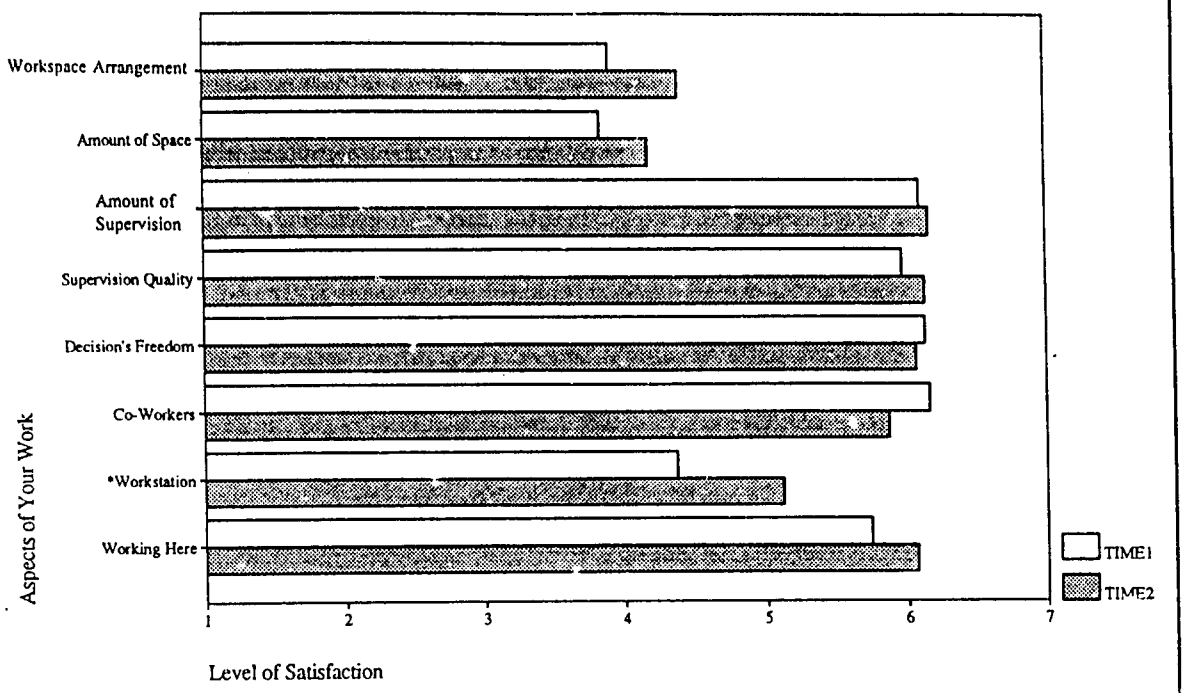
Figure 25. Rating co-workers doing the work.

work. Interestingly, people rated co-workers' ability to get along with others as slightly less (p=0.07, Figure 23) at Time 2 than at Time 1. Again, the "settling in" process still may have been underway at Time 2.

General Satisfaction. Figure 26 shows the average response for eight satisfaction questions. Satisfaction is a personal outcome of the work environment. The renovation was expected to have a general effect on all aspects of satisfaction, but the more specific workstation aspects (e.g., physical arrangement) were the most likely to be affected by the changes and were expected to show stronger effects. This did happen. Figure 26 shows there were no statistically significant differences; however, four items approached significance, and the general pattern of change was in the direction anticipated. The only item that showed an apparent decline at Time 2 (p=0.06) was satisfaction with co-workers. In contrast, and in the hypothesized direction, was the tendency for improvement in satisfaction with the workstation in general (p=0.06) and satisfaction with "working here" (p=0.12).

Overview of t-Test Results

There were more differences between Time 1 and Time 2 than could be expected by chance, but the sample size is small (N=33). Therefore generalizations should



1=Very Dissatisfied, 4=Neither, 7=Very Satisfied. *Significantly different at 0.05, or less.

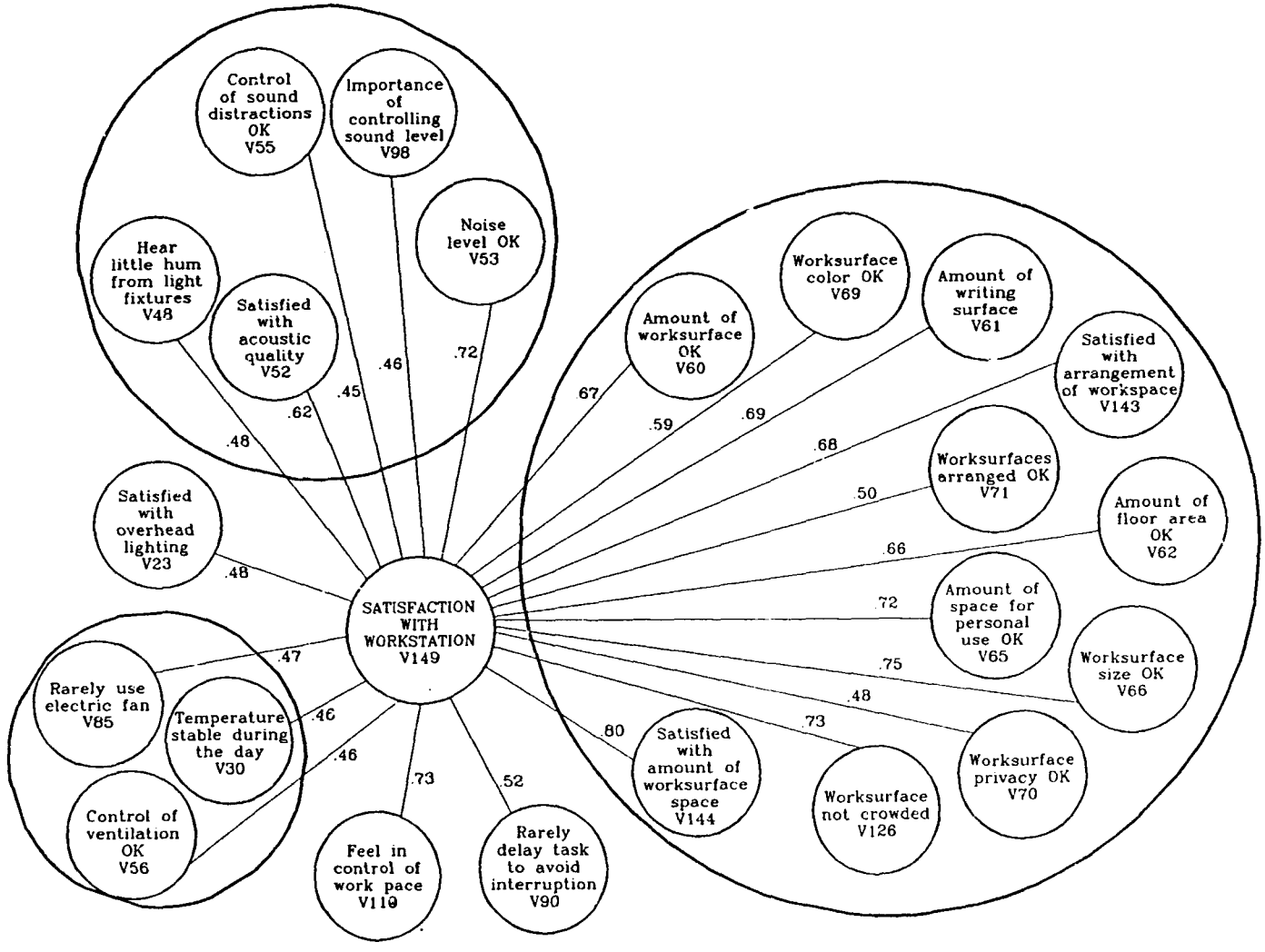
Figure 26. Satisfaction with aspects of work.

be conservative. However, with a larger sample size, many of the results that approached significance might well have been statistically significant. Results generally were consistent with expectations; and when they were not (e.g., see Figure 23, discussion of physical symptoms), there is a reasonable potential explanation. Additional longitudinal research is needed to clarify these issues.

Correlations Among Work Issues and Satisfaction

Correlation is a measure of the relationship between two variables. These results are from Pearson r correlational analyses, where the responses from Time 2 (after the changes) are related to people's satisfaction with the workstation (V149) and their satisfaction with working here (V150).

Satisfaction With the Workstation. Figure 27 presents the variables that were significantly correlated (p equal to or less than 0.05) with satisfaction with the workstation (V150). The variables represent five general categories of workstation conditions. Three deal with temperature and ventilation, five address acoustical conditions, one deals with lighting, and 11 focus on amounts and types of workstation conditions that primarily deal with amount of various spaces and



V refers to variable numbers on the questionnaire. p is less than or equal to 0.05.

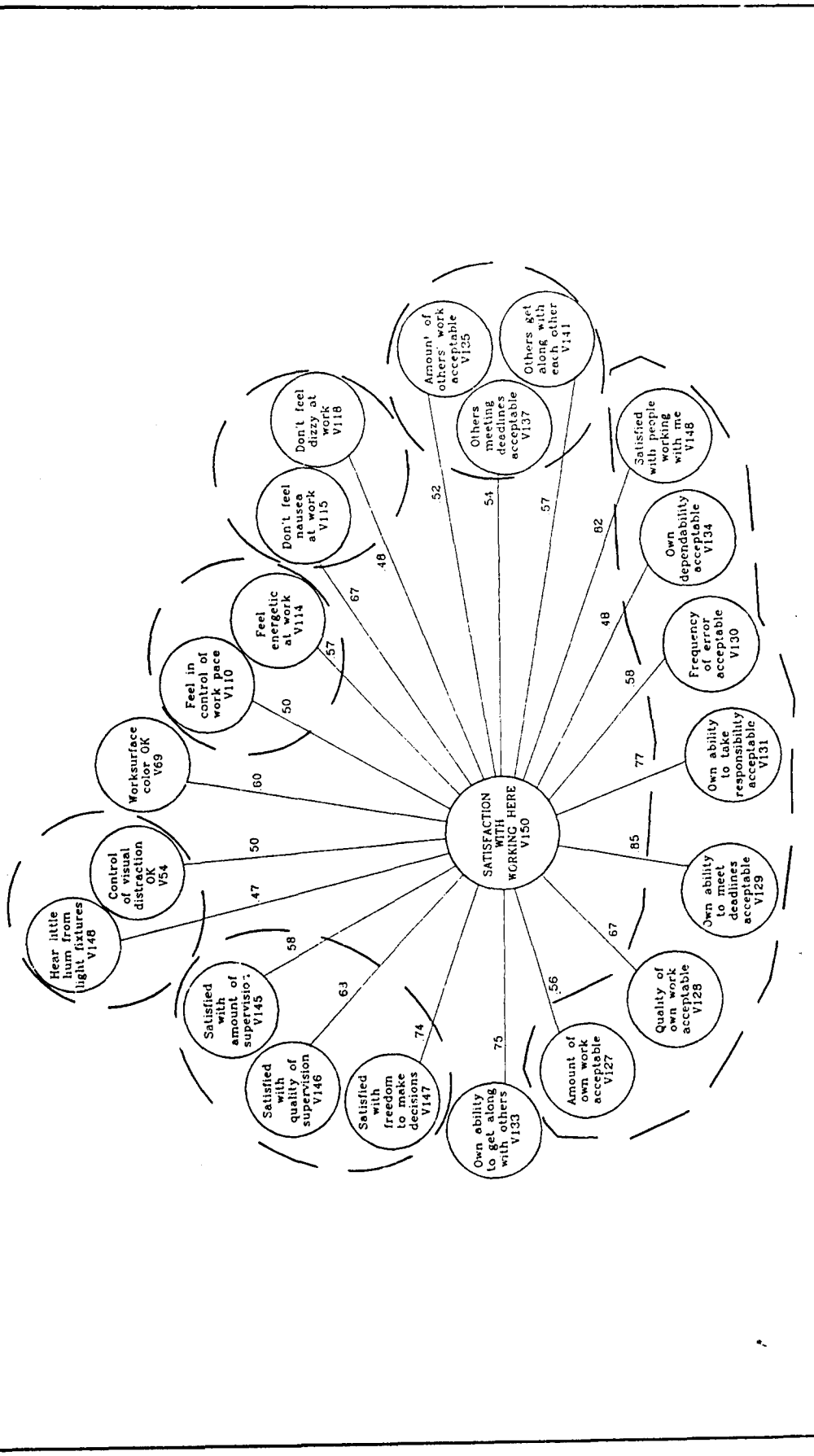
Figure 27. Variables correlated with satisfaction with workstation Time 2 (V149).

privacy aspects. All of these relationships indicate that the more adequately the conditions were fulfilled, the more satisfied respondents were with their workstation.

Two other items suggest why it is important that workstation conditions be considered adequate and supportive of the activities that must occur in them. To the extent that people felt satisfied with their workstation, they also felt they were able to adequately take responsibilities and were able to meet deadlines at an acceptable rate. These variables could be considered intermediate "outcomes" of a suitable work situation. Because they are found to be related to satisfaction of the workstation itself, the complex relationships between physical characteristics of the work setting and more general outcomes such as satisfaction are emphasized.

Satisfaction With Working Here. Although satisfaction with the workstation is a rather general response to the work setting, it is more specifically focused than satisfaction with "working here, in general." Therefore, relationships with "working here" that are not limited to physical aspects of the work setting would be expected. Figure 28 shows that this is true. A few specific characteristics positively related to the satisfaction with the "working here" question. Two of these have to do with distractions--hearing a hum from light fixtures and having adequate control over visual distractions. One is a more aesthetic evaluation and deals with adequacy of the colorfulness of the workstation. The remainder of the variables that were significantly correlated to satisfaction with "working here" are not evaluations of the physical environment. They fall into a number of other categories. Three items deal with management-related issues. To the extent that people were satisfied with the quality of supervision (V146), the amount of supervision (V145), and their freedom to make decisions (V147), they were more satisfied with "working here." Co-workers were also a factor. When they felt that the amount of work others did (V135), others' ability to meet deadlines (V137), and others' ability to get along with co-workers (V141) were acceptable, they were more satisfied with "working here." Satisfaction with the people working with me (V148) was also highly correlated with satisfaction with "working here."

An important part of the questionnaire dealt with learning more about the nature of experiences workers had while on the job. These also were more specific than asking about level of general satisfaction. Two of these items in Figure 28 address symptoms of physical discomfort; people who did not experience nausea or dizziness at work were more satisfied. Two other items dealt with emotional experiences; those who felt energetic at work and in control of the pace of their work also were more satisfied with "working here."



V refers to variable numbers on the questionnaire. p is less than or equal to 0.05.

Figure 28. Variables correlated with satisfaction with workstation Time 2 (V150).

Finally, there is the question of the relationship between satisfaction and work performance. No independent measures of worker performance were available, but a set of items was used to allow people to do a self-evaluation of various aspects of their own performance, in terms of how acceptable they were. Seven of the eight items in the questionnaire were positively (some quite strongly) correlated with satisfaction with "working here." To the degree that people rated their amount (V127) and quality of work (V128), and their ability to meet deadlines (V129) and take responsibility (V131), had low frequency of errors (V130), felt they were dependable (V134), and felt their own ability to get along with co-workers was acceptable (V133), they were more likely to be satisfied with "working here."

Satisfaction With Workstation and Working Here. The worker's answers clearly show the complex relationships among many aspects of the work environment, and many of the hypothesized results were supported. Yet one of the expected relationships did not receive statistical support. Although there was a correlation (r=0.40) between the more specific workstation satisfaction and the more general satisfaction with "working here," and it was in the expected direction, it was not statistically significant. Once again the small sample size may be a factor in these results.

Implications for Model Development and Testing. The results from the bivariate correlational analyses can be thought of as a preliminary stage in the development of more sophisticated multivariate models. When thinking in a sequential hierarchal manner, a set of hypothetical relationships that could become something more than a description of results could be proposed, as the correlational figures are. For example, the evaluation of specific environmental characteristics (e.g., amount of workstation floor area or sound levels) could be related to more general perceptual evaluations (e.g., level of privacy). This percepetion of privacy might, in turn, be directly related to an even more general outcome (e.g., satisfaction with workstation). This kind of logic could be extended to include more of the variables under study. After developing such a model of hypothesized relationships, statistical techniques can be used to empirically test the adequacy of the model in explaining any general outcome variable (e.g., satisfaction with workspace, productivity, etc.). A multivariate analysis (instead of the bivariate correlations) can provide more information. It can tell not only how well an outcome can be predicted, but it also can indicate the relative importance of the predictors. Information like that can then be used to prioritize decisions about actions to be taken.

4 Conclusions

USACERL began to address the theory that environmental improvements in the workplace can lead to greater productivity and improved employee satisfaction in 1986 (Francis et al.). The current study incorporated concepts and findings from the earlier USACERL study to evalute worker productivity and satisfaction both before and after an office renovation.

One of the tools available for obtaining information about how users perceive their work environments is the questionnaire, "Evaluating Office Environments" (see Appendix). This questionnaire, which was used in this evaluation of HECSA workspaces, had been redesigned from earlier questionnaires. Its use in this study tested the appropriateness and effectiveness of the changes to the questionnaire. This questionnaire also has been tested in more than a dozen different office environments, and a baseline of data has been developed so comparison can easily be made. This original paper and pencil questionnaire is being converted to a computer-based system, which will facilitate obtaining information from users, speed data analysis, and enhance the presentation of implications for design.

The workers at a support office at HECSA were surveyed and asked to fill out a questionnaire both before and after an office renovation. The results of this study provide a clear demonstration that obtaining information from users before changes are made in office space (e.g., via the programming survey or questionnaire) and using that information in development of the redesign can result in positive work outcomes. The importance of a follow-up, post occupancy evaluation that challenges the redesigned product also is illustrated.

The study shows the information that should be obtained from users before the redesign of office space (see Figures 27 and 28), it emphasizes the importance of obtaining the information before the redesign process is implemented, and it gives details on how information can be obtained and analyzed. The methods of addressing a number of relevant design problems and proving successes also were discussed. The survey and questionnaire methods of gathering information from the users of the facility can be used again after changes have been made to test the improvements in workstation conditions or to identify problem areas.

The results of this study support the use of detailed programming that showed the most successes occurred in the areas that received the most explicit attention in the programming questionnaire. The results begin to suggest a model of

workstation satisfaction that indicates the relative importance of specific workplace characteristics for satisfaction. Information is provided, through the use of the survey (questionnaire), that can be used by facility managers to identify areas in a facility that appear to have environmental problems. Those problem aspects then can be changed to improve the work environment.

Success of Detailed Programming

One of the primary expectations of the design solution was that workers would be especially responsive to specific changes in the workstation setting. The HECSA design programming questionnaire (Figure 4) asked specifically about storage issues, space layouts and amounts, and equipment needs. These were addressed in the remodeling. The evaluation questionnaire also asked about these issues to see if improvements had occurred. The results of these evaluations of various specific workstation characteristics showed that a majority of issues were improved at Time 2, as expected. Provisions for controlling visual distractions and light levels were perceived to be better. The amount of work surface, file space, space for computer materials, and shelving were improved. The amount of space for personal items and the amount of privacy provided by the workspace also were believed to be better at Time 2. Thus, many of the issues that initially had been identified as problems and were dealt with in the redesign also were perceived by workers in a more positive manner. This is an example of how the remodeling was successful. The data confirm that the design provided a greater sense of space, even when the amount of actual space was not increased overall but generally decreased.

Potential Model for Predicting Workstation Satisfaction

The correlational findings suggest that positive evaluations of specific workstation aspects (such as temperature, lighting, acoustics, ventilation, and amount of space for various features) are related to satisfaction with the workstation. Privacy also was related to satisfaction. Previous work by Weidemann and Anderson (1992) presented empirical results which would suggest that a conceptual model could be developed and tested by path analysis. Such analyses could indicate which of the workstation characteristics were most strongly related to perceptions of privacy and satisfaction with the workstation. A larger sample size would be important for these analyses, but it could provide much more specific information about how well satisfaction could be predicted and about the relative importance of various characteristics for that satisfaction. When resources for new facilities or for

change in existing facilities are scarce, information from the test of a model could be extermely important in setting priorities for change.

The Identification of Problem Areas

Another finding in this quasi-experiment, and one which was unexpected yet important, demonstrates the importance of evaluating work environments after changes have been made. A number of outcomes reported from working in the original and remodeled office environments were physical in nature; and three of these were worse after the remodeling: headaches, nausea, and wrist/arm soreness, perhaps due to a slight sick building situation because of the "offgassing" of the new materials. Two other physical conditions approached statistical significance; they indicated an increase in respiratory problems and throat irritation after the changes.

Also in contrast to expectations, the perceptions of temperature conditions worsened at Time 2. People felt that stable temperature conditions occurred less often in the new environment and were less satisfied with the workstation temperature at Time 2.

5 Recommendations

Although good interior design is believed to improve the quality of a work environment, and thus the performance of the worker, it is recommended that the success of design decisions be tested. The quasi-experiment discussed here is only one example of a number of studies that have shown the value of appropriate interior design. Furthermore, it is recommended that the research go beyond basic descriptive information to be of full value. When dollars and resources are limited, any information that can suggest priorities for changes is important and useful. Research on the value of good interior design (e.g., as it relates to type of space, levels of privacy, etc.) has shown its importance in terms of major outcomes such as job satisfaction and enhanced performance (Heinen et al., March 1994).

It is recommended that the existing base of knowledge of interior design in the work environment be extended, that this knowledge be applied to real situations, and that the extent and nature of the success of office design continue to be monitored.

It is recommended that information obtained from any questionnaire be used to locate the specific spaces in an office environment that received lower, or problem, ratings. These problem areas can be the result of new facility planning needs or ongoing, proactive facility management. After these areas are identified, a decision can be made about whether certain changes could be done to those specific locations.

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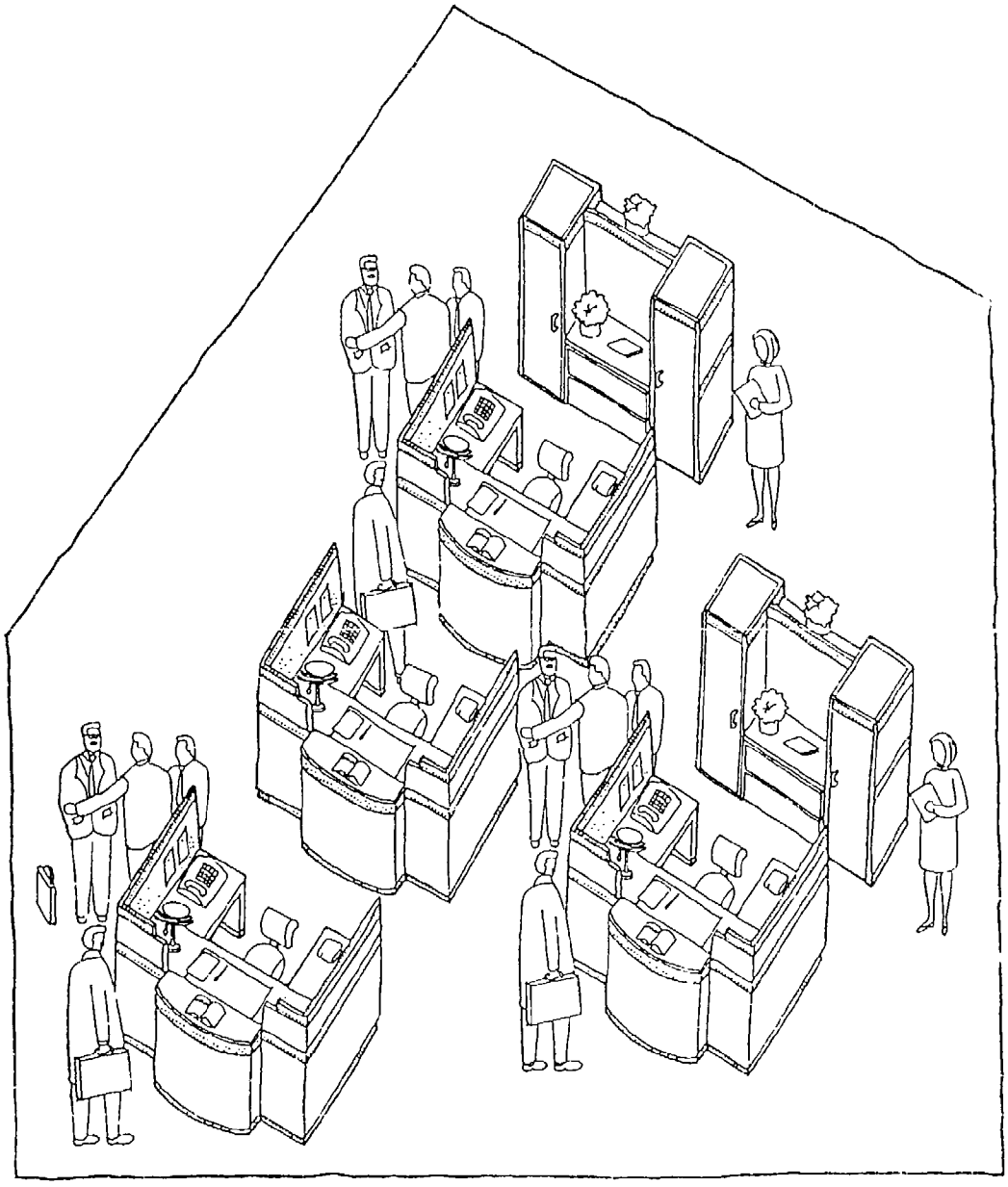
Appendix: Evaluating Office Environments*

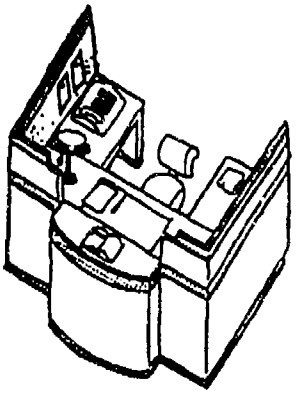


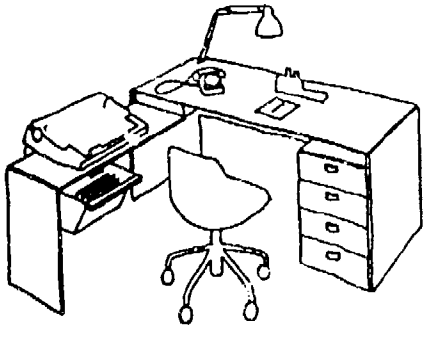
EVALUATING
OFFICE ENVIRONMENTS

*From the Facilities Management Division, USACERL.

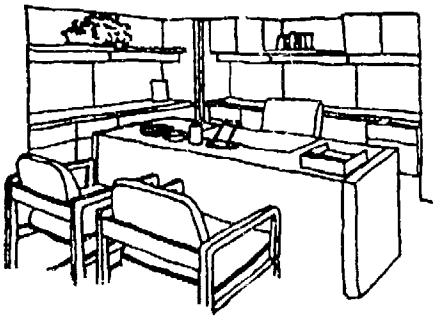
As you read through this questionnaire, you will find many references to **WORKSTATION**. This is the assemblage of furniture, shelving, cabinets and equipment arranged for **YOUR USE**. Your workstation may be in a room by itself or in a room with other individual's workstations. There are also a few places where we would like you to think about your **WORK SPACE**. This includes your workstation, but also the space adjacent to it.

EXAMPLES OF WORKSTATIONS





EXAMPLES OF WORK SPACE



WORKSTATION ACTIVITIES

Please ESTIMATE for each of the following, HOW MUCH OF YOUR WORK DAY IS USUALLY SPENT:

		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Does Not Apply
V1	At your workstation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
V2	In conference rooms	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V3	In other locations in your building	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Please ESTIMATE for the following HOW MUCH OF YOUR DAY AT YOUR WORKSTATION IS USUALLY SPENT:

		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
V4	Using a computer or a computer terminal	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V5	Using a typewriter	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V6	Reading papers or documents	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
V7	Writing papers or documents	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
V8	Drawing, illustrating or laying out material	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V9	In work related face-to-face conversation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
V10	In work related telephone conversation	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Please ESTIMATE for each of the following HOW OFTEN THESE OCCUR IN AN ORDINARY WORK WEEK.

		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Does Not Apply
V11	I am interrupted by people entering my work space	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V12	Interupted by distractions around my work space	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V13	Completely caught up on my work	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

WORKSTATION ENVIRONMENT

LIGHTING

Please ESTIMATE for each of the following HOW FREQUENTLY THESE OCCUR:

		ALWAYS			SOMETIMES			NEVER	Does Not Apply
V14	I am aware of glare in my work space	☐	☐	☐	☐	☐	☐	☐	☐
V15	The artificial lighting gives objects an un-natural color	☐	☐	☐	☐	☐	☐	☐	☐
V16	I like fluorescent lights	☐	☐	☐	☐	☐	☐	☐	
V17	I like incandescent lights	☐	☐	☐	☐	☐	☐	☐	
V18	I am aware of working in my shadow	☐	☐	☐	☐	☐	☐	☐	
V19	I prefer to work by a window	☐	☐	☐	☐	☐	☐	☐	
V20	The positions of light fixtures seem to be wrong	☐	☐	☐	☐	☐	☐	☐	☐
V21	I have sufficient control of lighting at my workspace	☐	☐	☐	☐	☐	☐	☐	
V22	I am satisfied with the task lighting at my workstation	☐	☐	☐	☐	☐	☐	☐	☐
V23	I am satisfied with the overhead lighting	☐	☐	☐	☐	☐	☐	☐	☐

Please ESTIMATE for each of the following HOW YOU EXPERIENCED THE LIGHTING AT YOUR WORKSTATION DURING THE LAST WEEK:

		TOO DIM			JUST RIGHT			TOO BRIGHT			
V24	Reading documents	☐	☐	☐	☐	☐	☐	☐	☐	☐	
V25	Reading a computer screen	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V26	Writing on the desktop	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V27	Conversing with others	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
V28	In general, the light level at my workstation is:	☐	☐	☐	☐	☐	☐	☐	☐	☐	

What are the good things about the lighting at your workstation?

What are the bad things about the lighting at your workstation?

TEMPERATURE

Please ESTIMATE for each of the following HOW FREQUENTLY EACH OCCURS:

		ALWAYS			SOMETIMES			NEVER	Does Not Apply
V29	The sun sometimes makes my workstation TOO HOT.	☐	☐	☐	☐	☐	☐	☐	☐
V30	The temperature at my workstation is STABLE during the day.	☐	☐	☐	☐	☐	☐	☐	
V31	I am satisfied with the temperature at my workstation	☐	☐	☐	☐	☐	☐	☐	

Please ESTIMATE your general perception of the TEMPERATURE while AT YOUR WORKSTATION.

V32 During the Summer

				JUST RIGHT					
TOO HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO COLD

V33 During the Winter

				JUST RIGHT					
TOO HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO COLD

Please ESTIMATE your perception of the TEMPERATURE AT YOUR WORKSTATION THIS LAST WEEK:

V34 During the Morning

				JUST RIGHT					
TOO HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO COLD

V35 During the Afternoon

				JUST RIGHT					
TOO HOT	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO COLD

What are the good things about temperature conditions at your workstation?

What are the bad things about temperature conditions at your workstation?

WORKSTATION ENVIRONMENT

AIR QUALITY

Please **ESTIMATE** for each of the following **HOW FREQUENTLY THEY OCCUR AT YOUR WORKSTATION:**

		ALWAYS			SOMETIMES			NEVER
V36	I am aware of UNPLEASANT ODORS while at my workstation	☐	☐	☐	☐	☐	☐	☐

Please describe any common odors: _____

V37	I am aware of tobacco SMOKE in the air	☐	☐	☐	☐	☐	☐	☐
V38	I am aware of DUST in the air	☐	☐	☐	☐	☐	☐	☐
V39	I am SATISFIED with the air quality at my workstation	☐	☐	☐	☐	☐	☐	☐

Please **ESTIMATE** your perception of **THE QUALITY OF THE AIR AT YOUR WORKSTATION:**

During the Summer

					JUST RIGHT					
V40	TOO DRY	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO HUMID
V41	TOO DRAFTY	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO STUFFY
V42	TOO FRESH	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO STALE

During the Winter

					JUST RIGHT					
V43	TOO DRY	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO HUMID
V44	TOO DRAFTY	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO STUFFY
V45	TOO FRESH	☐	☐	☐	☐	☐	☐	☐	☐	☐ TOO STALE

ACOUSTICS

Please ESTIMATE for each of the following HOW FREQUENTLY THEY OCCUR:

		ALWAYS						NEVER	DOES NOT APPLY
V46	I hear air blowing through the ducts	☐	☐	☐	☐	☐	☐	☐	☐
V47	I overhear others talking	☐	☐	☐	☐	☐	☐	☐	☐
V48	I hear hum from the light fixtures	☐	☐	☐	☐	☐	☐	☐	
V49	I hear noise from office copiers	☐	☐	☐	☐	☐	☐	☐	☐
V50	I hear noise from typewriters and printers	☐	☐	☐	☐	☐	☐	☐	☐
V51	I hear noise from the mechanical equipment	☐	☐	☐	☐	☐	☐	☐	
V52	I am satisfied with the ACOUSTIC QUALITY of my workstation	☐	☐	☐	☐	☐	☐	☐	

Indicate your general perception of the LEVEL OF NOISE at your workstation.

				JUST RIGHT					
V53	TOO NOISY	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO QUIET

Please describe any specific problems you have with noise or sounds.

Please describe any specific features of the acoustics of your workstation that are good.

WORKSTATION CHARACTERISTICS

This next section asks for **YOUR EVALUATION OF** a number of different **CHARACTERISTICS OF YOUR WORKSTATION.** Please check the response that best describes how you feel.

		TOO LITTLE			JUST RIGHT			TOO MUCH	Does Not Apply
V54	Provisions for controlling visual distractions	☐	☐	☐	☐	☐	☐	☐	
V55	Provisions for controlling sound distractions	☐	☐	☐	☐	☐	☐	☐	
V56	Provisions for controlling ventilation	☐	☐	☐	☐	☐	☐	☐	
V57	Provision for controlling temperature	☐	☐	☐	☐	☐	☐	☐	
V58	Provisions for controlling light levels	☐	☐	☐	☐	☐	☐	☐	
V59	Provisions for rearranging my workstation furniture	☐	☐	☐	☐	☐	☐	☐	
V60	The amount of work surface	☐	☐	☐	☐	☐	☐	☐	
V61	The amount of writing surface	☐	☐	☐	☐	☐	☐	☐	
V62	The amount of floor area at my workstation	☐	☐	☐	☐	☐	☐	☐	
V63	The amount of file drawer space	☐	☐	☐	☐	☐	☐	☐	
V64	The amount of shelving	☐	☐	☐	☐	☐	☐	☐	
V65	The amount of space for personal items	☐	☐	☐	☐	☐	☐	☐	
V66	The amount of privacy my workspace provides	☐	☐	☐	☐	☐	☐	☐	
V67	Space provided beside my computer for material I can type from	☐	☐	☐	☐	☐	☐	☐	☐

Indicate your general perception of the characteristics of your workstation.

			JUST RIGHT							
V68	TOO LARGE	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO CRAMPED
V69	TOO DRAB	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO COLORFUL
V70	TOO PUBLIC	☐	☐	☐	☐	☐	☐	☐	☐	☐	TOO PRIVATE

Indicate how much you agree or disagree with each of the following:

		STRONGLY AGREE						STRONGLY DISAGREE	
V71	Work surfaces at my workstation are arranged poorly	☐	☐	☐	☐	☐	☐	☐	
V72	The furniture and equipment at my workstation are arranged poorly	☐	☐	☐	☐	☐	☐	☐	
V73	I am satisfied with the temperature at my workstation	☐	☐	☐	☐	☐	☐	☐	
V74	My job requires constant concentration	☐	☐	☐	☐	☐	☐	☐	
V75	People that I work with make my job enjoyable	☐	☐	☐	☐	☐	☐	☐	
V76	The chair at my workstation is comfortable	☐	☐	☐	☐	☐	☐	☐	Does Not Apply
V77	My work surfaces are all very stable	☐	☐	☐	☐	☐	☐	☐	
V78	Partitions around my workstation are very attractive	☐	☐	☐	☐	☐	☐	☐	☐

Please ESTIMATE for each of the following HOW FREQUENTLY EACH OF THESE OCCUR:

		ALWAYS			SOMETIMES			NEVER	
V79	I adjust parts of my workstation	☐	☐	☐	☐	☐	☐	☐	
V80	I adjust the height of my chair	☐	☐	☐	☐	☐	☐	☐	
V81	I adjust the position of the back of my chair	☐	☐	☐	☐	☐	☐	☐	
V82	I adjust the location of my keyboard	☐	☐	☐	☐	☐	☐	☐	☐
V83	I adjust the thermostat	☐	☐	☐	☐	☐	☐	☐	☐
V84	I use a space heater in the winter	☐	☐	☐	☐	☐	☐	☐	
V85	I use an electric fan	☐	☐	☐	☐	☐	☐	☐	
V86	I adjust a window for air	☐	☐	☐	☐	☐	☐	☐	☐
V87	I adjust window shades, blinds, or curtains	☐	☐	☐	☐	☐	☐	☐	☐
V88	I adjust the amount of artificial light	☐	☐	☐	☐	☐	☐	☐	
V89	I adjust the contrast or brightness on my computer screen	☐	☐	☐	☐	☐	☐	☐	☐
V90	I delay a task to avoid being interrupted by others	☐	☐	☐	☐	☐	☐	☐	

FOR YOUR JOB

To do your job well, how important or unimportant are each of the following.

		VERY IMPORTANT						NOT IMPORTANT
V91	Visual access to co-workers	☐	☐	☐	☐	☐	☐	☐
V92	Easy ability to talk with co-workers	☐	☐	☐	☐	☐	☐	☐
V93	Visual privacy from co-workers	☐	☐	☐	☐	☐	☐	☐
V94	Acoustic privacy from co-workers	☐	☐	☐	☐	☐	☐	☐
V95	Your control of light level	☐	☐	☐	☐	☐	☐	☐
V96	Your control of ventilation	☐	☐	☐	☐	☐	☐	☐
V97	Your control of temperature	☐	☐	☐	☐	☐	☐	☐
V98	Your control of sound level	☐	☐	☐	☐	☐	☐	☐
V99	Controlling whom enters your workstation	☐	☐	☐	☐	☐	☐	☐
V100	Controlling arrangement of your workstation and equipment	☐	☐	☐	☐	☐	☐	☐
V101	Working in a room with others	☐	☐	☐	☐	☐	☐	☐
V102	Working in a room by yourself	☐	☐	☐	☐	☐	☐	☐
V103	Having easy access to lounge and break areas	☐	☐	☐	☐	☐	☐	☐
V104	The ORGANIZATIONAL environment, in helping people to be productive here	☐	☐	☐	☐	☐	☐	☐
V105	The MANAGEMENT environment in helping people to be productive here	☐	☐	☐	☐	☐	☐	☐
V106	The INTERPERSONAL environment (e.g., people you work with) in helping people to be productive here	☐	☐	☐	☐	☐	☐	☐
V107	The PHYSICAL environment, in helping people to be productive here	☐	☐	☐	☐	☐	☐	☐

WORK EXPERIENCES

Please indicate **HOW FREQUENTLY EACH EXPERIENCE OCCURS FOR YOU, ON THE AVERAGE.**

	WORK-RELATED EXPERIENCE	FREQUENCY OF EACH EXPERIENCE				
		ALWAYS	OFTEN	SOMETIMES	RARELY	NEVER
V108	Feeling excited about my work	1	2	3	4	5
V109	Feeling inadequately trained for the work that I do	1	2	3	4	5
V110	Feeling in control of the pace of my work	1	2	3	4	5
V111	Feeling overworked	1	2	3	4	5
V112	Feeling strongly involved in my work	1	2	3	4	5
V113	Headaches while at work	1	2	3	4	5
V114	Feeling energetic at work	1	2	3	4	5
V115	Nausea while at work	1	2	3	4	5
V116	Respiratory problems while at work	1	2	3	4	5
V117	Contact lens irritation while at work	1	2	3	4	5
V118	Feeling dizzy while at work	1	2	3	4	5
V119	Eye irritation while at work	1	2	3	4	5
V120	Nasal congestion while at work	1	2	3	4	5
V121	Throat irritation while at work	1	2	3	4	5
V122	Feeling distracted by too many telephone calls	1	2	3	4	5
V123	Soreness in arms, wrists or hands while at work	1	2	3	4	5
V124	Soreness in lower back while at work	1	2	3	4	5
V125	Soreness in neck and shoulders while at work	1	2	3	4	5
V126	Feeling cramped or crowded in my work area	1	2	3	4	5

DOING THE WORK

Check the box which best reflects how you rate each of the following.

FOR YOURSELF

		ABSOLUTELY NOT ACCEPTABLE						ABSOLUTELY IDEAL
V127	Amount of work accomplished	☐	☐	☐	☐	☐	☐	☐
V128	Quality of work accomplished	☐	☐	☐	☐	☐	☐	☐
V129	Meeting deadlines	☐	☐	☐	☐	☐	☐	☐
V130	Frequency of errors	☐	☐	☐	☐	☐	☐	☐
V131	Taking responsibility	☐	☐	☐	☐	☐	☐	☐
V132	Creativity	☐	☐	☐	☐	☐	☐	☐
V133	Getting along with others	☐	☐	☐	☐	☐	☐	☐
V134	Dependability	☐	☐	☐	☐	☐	☐	☐

FOR YOUR CO-WORKERS

V135	The amount of work accomplished	☐	☐	☐	☐	☐	☐	☐
V136	Quality of work accomplished	☐	☐	☐	☐	☐	☐	☐
V137	Meeting deadlines	☐	☐	☐	☐	☐	☐	☐
V138	Frequency of errors	☐	☐	☐	☐	☐	☐	☐
V139	Taking responsibility	☐	☐	☐	☐	☐	☐	☐
V140	Creativity	☐	☐	☐	☐	☐	☐	☐
V141	Getting along with others	☐	☐	☐	☐	☐	☐	☐
V142	Dependability	☐	☐	☐	☐	☐	☐	☐

SATISFACTION

This section asks how SATISFIED or DISSATISFIED you are with a number of different aspects of your work. Please indicate the box which best describes how you feel.

		VERY DISSATISFIED			NEITHER			VERY SATISFIED
V143	The physical arrangement of your workspace	☐	☐	☐	☐	☐	☐	☐
V144	The amount of space at your workstation	☐	☐	☐	☐	☐	☐	☐
V145	The amount of supervision you receive	☐	☐	☐	☐	☐	☐	☐
V146	The quality of supervision you receive	☐	☐	☐	☐	☐	☐	☐
V147	Your freedom to make decisions about your work	☐	☐	☐	☐	☐	☐	☐
V148	The people working with you	☐	☐	☐	☐	☐	☐	☐
V149	Your workstation, in general	☐	☐	☐	☐	☐	☐	☐
V150	Working here, in general	☐	☐	☐	☐	☐	☐	☐

ABOUT YOURSELF

The following information will help us to understand how different types of people feel about perception of the work environment.

V151 What is the best description of your work environment?

_____ A workstation in a room of its own
_____ A workstation separated by partitions from others
_____ A workstation in a room with others and no separation

V152 Your Job Title: _____

How long have you worked at your present workstation? ____years ____months

How long have you worked in your present building? ____years ____months

How many hours are you scheduled to work per day? _____hours

How frequently do you work more hours than scheduled?

ALWAYS ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ NEVER

What is your sex? ___female ___male What is your age? _____years

TODAY'S WEATHER

What is the approximate outdoor temperature? _____

Is today's weather: ___cloudy ___sunny ___rainy ___snowy ___windy ___other

TODAY'S DATE: _____

Thank you for your help!

We welcome any comments that you have about this questionnaire, or about where you work.

If you know APPROXIMATELY HOW LONG IT TOOK YOU TO COMPLETE this questionnaire, please tell us. _____minutes

Did you find that the number of choices for the questionnaire items were

_____Too few
_____Ok
_____Too many

Were there questions that you did not understand?

_____Yes
_____No

IF YES, HELP US BY GOING BACK TO THEM AND CIRCLING THEM. Any notes that you have about the questions would also be appreciated.

PLEASE COMPLETE! YOUR NAME _____ SECTION _____

PLEASE FEEL FREE TO WRITE ANY ADDITIONAL COMMENTS ABOUT YOUR WORK ENVIRONMENT IN THE SPACE BELOW.

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