

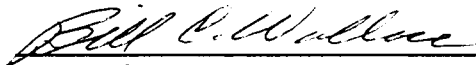
To the Graduate Council:

I am submitting herewith a thesis written by Jamie K. Arnold, entitled "Computer Workstation Survey". I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Safety Education and Service.



Robert H. Kirk
Major Professor

We have read this thesis and
recommend its acceptance:



Accepted for the Council:



Associate Vice Chancellor
and Dean of the Graduate
School

COMPUTER WORKSTATION SURVEY

A Thesis

Presented for The

Master of Science

Degree

The University of Tennessee, Knoxville

Jamie K. Arnold

December 1995

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Last, but certainly not least, special thanks to all respondents who participated in the Computer Workstation Surveys. I hope the suggested changes made significant improvements, where signs and symptoms were identified.

ABSTRACT

The primary purpose of this research was to assess the possible need for and functions of computer workstation assessments in the office workstations at the United States Department of Energy, Oak Ridge Operations Division at the Federal Building. The secondary purpose was to establish the need for efficiency through these assessments. The essence of the research problem was to determine if employees suffered from signs and symptoms, and if so, attempt to formulate a relationship between the signs and symptoms and other factors in the workstation. Over a five week period, 177 employees were assessed at their computer workstations, using the COMPUTER WORKSTATION QUESTIONNAIRE. The results of the research revealed consistency between the ages of those who suffered from signs and symptoms related to their work activities, and those who did not have signs and symptoms, as well as some other interesting relationships in the data.

It was concluded that computer workstation assessments should be conducted, especially for employees who work at their computer workstations from 4 to 8 hours each day.

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CHAPTER I

THE PROBLEM

Day after day, people work diligently at their computer workstations. Some type for only minutes at a time to check their electronic mail and file reports, while others type at the keyboard for hours, sometimes missing breaks to meet a deadline. These repeated motions can be the beginning of serious health problems. "Workplace illnesses associated with repeated trauma (e.g. conditions due to repeated pressure, vibration, or motion such as carpal tunnel syndrome) accounted for almost 224,000 cases, or slightly more than 60 percent of the new illness cases reported in 1991. Over the past several years, disorders associated with repeated trauma have increased both in number and as a percent of total illnesses reported" (Bureau of Labor Statistics, 1992). An article published in the Saturday, November 5, 1994 edition of the Knoxville News Sentinel quotes Joseph Dear, the Assistant Labor Secretary in charge of the Occupational Safety and Health Administration, as stating, "The Labor Department hopes to pass regulations aimed at protecting workers from 'repetitive motion' injuries before the end of President Clinton's first term,

or January 1997 and a court challenge is 'a certainty'" (Associated Press, 1994). This article also contained information from the Bureau of Labor Statistics which showed, "almost 90,000 U.S. workers lost time from their jobs in 1992 because of repetitive strain injuries, such as carpal tunnel syndrome" and that "such cases made up 21 percent of occupational illnesses in 1982 but, jumped to 62 percent in 1992" (Associated Press, 1994). The United States Occupational Safety and Health Administration (OSHA) has proposed an ergonomics standard titled, "Ergonomics Program Management Recommendations for General Industry"; however, it is still in draft form. The problem remains that workers are using inadequate or ergonomically incorrect equipment daily at their workstations and some are suffering the consequences with signs and symptoms related to carpal tunnel syndrome. Table I-1 presents data from Tountas et al (1983) which showed that, "carpal tunnel cases which had been labeled as workers' compensation cases were less likely to have good operative (surgical) results" (Rosenbaum and Ochoa, 1993). There are nonsurgical treatments for carpal tunnel syndrome; however, "in some patients with acute carpal tunnel syndrome and associated neurological deficit, surgical therapy should not be delayed" (Rosenbaum and Ochoa, 1993). With such a dramatic increase in cumulative trauma disorders (CTDs), something must be done to prevent these injuries before they occur.

TABLE I-1
CARPAL TUNNEL SURGERY AND WORKERS' COMPENSATION

SURGICAL RESULT	WORKER'S COMPENSATION	
	YES %	NO %
GOOD	66	85
FAIR	23	11
POOR	11	4

(Data from Tountas et al. 1983.) (Rosenbaum and Ochoa, 1993)

The question was, "Are ergonomic assessments necessary and worthwhile in today's office workstations?" Currently, there is no standard of law in place to regulate ergonomic problems. Identification and recommendations for corrective actions to ergonomic problems can be determined by a qualified person who should perform ergonomic assessments of each office workstation (it is duly noted that an ergonomic assessment should be conducted at each workstation in the company, including office workstations and industrial workstations; however, for the purpose of this research, only computer workstations shall be considered and discussed). This qualified person must provide an unbiased assessment of the ergonomic situation in the company. The questions of severity and correction can be answered through the findings of the completed office workplace assessment. A belief that companies care about the health of their employees and their level of productivity was the foundation on which this study was based.

I. PURPOSE OF THE STUDY

The primary purpose of this study was to survey the possible need for and functions of computer workstation assessments in the office workstations at the United States Department of Energy, Oak Ridge Operations Division at the

Federal Building. The secondary purpose was to establish the need for efficiency through these assessments.

II. RESEARCH QUESTIONS

The basic premise of this investigation was that the user of the computer workstation is ultimately held responsible for the workstation and must use equipment provided by the employer for that office workstation to perform daily tasks. The survey problem was to address the following:

Question 1: Does the employee suffer from pain or symptoms related to work activities?

Question 2: Can recommendations be made to better the computer workstation ergonomically for the employee?

Question 3: Does the employee spend more than 4 hours at the computer daily?

Question 4: If the employee has signs and symptoms, have they affected work performance?

Question 5: If the employee has signs and symptoms, does the employee participate in outside/off work activities that may be strenuous or involve repetitive motion?

III. BASIC ASSUMPTIONS

The following are the assumptions related to this survey:

Assumption 1. The data collection instrument used in this study was judged to be valid and reliable.

Assumption 2. All responses given by employees were assumed to be honest.

Assumption 3. Confidentiality was maintained (no names or social security numbers were used).

IV. LIMITATIONS OF THE STUDY

Although ergonomics applies to all industries, this survey was limited to the ergonomic assessment of individual computer workstations in a selected government office building. An attempt was made to survey all employees in this facility; however, only assessments conducted on an initial basis were used in this study to determine validity.

The investigation was further limited by employees not wanting to disclose information regarding signs and symptoms, avoiding this situation with an inaccurate answer of "no", and employees creating signs and symptoms related to work activities to receive new equipment.

V. DELIMITATIONS OF THE STUDY

Boundaries were further defined to delimit the information to meaningful data for this research. The study was delimited to:

1. Initial ergonomic assessments of individual computer workstations at the United States Department of Energy, Oak Ridge Operations Division at the Federal Building.
2. Respondents who were grouped by department, sex, and pain identification to maintain confidentiality.

VI. NEED FOR THE STUDY

OSHA has identified the need for ergonomic awareness and control though the standard currently in draft form, "Ergonomics Program Management Recommendations For General

Industry". This standard is slated for release in early 1997 and will be the beginning of ergonomic change for many companies.

Recently, dramatic increases in the occurrence of cumulative trauma disorders (CTDs) and other work-related injuries and illnesses due to ergonomic hazards have been noted by the Bureau of Labor Statistics (OSHA, 1994). "Some of this increase may be attributed to increased awareness - by industry, labor, and government - and to the reporting of these disorders; but, most appear to be due to changes in production demands which expose employees to increased repetitive motion and other ergonomic risk factors" (OSHA, 1994). This OSHA draft standard also recommends the implementation of effective programs into the employer's safety and health management programs to protect the workers from ergonomic hazards (OSHA, 1994).

VII. DEFINITION OF TERMS USED

Unfamiliar terms were defined to clarify meaning and promote clear understanding of the investigation.

Ergonomic Assessment: A survey performed visually or by use of an instrument on an individual at their workstation to assess any present or potential ergonomic hazards.

Carpal Tunnel Syndrome (CTS): A repetitive motion disorder or injury of the wrist which is most commonly caused by chronic median nerve compression in the carpal canal (Rosenbaum and Ochoa, 1993).

Computer Workstation: The actual work area in which an individual performs daily office duties, centered around the computer.

Cumulative Trauma Disorder (CTD): "Term used for health disorders arising from repeated biomechanical stress due to ergonomic hazards" (OSHA, 1994).

Pain: Any unpleasant feeling or negative sensation to the human body, as determined in part three of the COMPUTER WORKSTATION QUESTIONNAIRE, resulting from ergonomic hazards such as improper working positions, lack of ergonomically correct equipment, and poor positioning of ergonomically correct equipment in the computer workstation.

Symptoms: Any indication of disorder or disease resulting from ergonomic hazards in the computer workstation, as determined in part three of the COMPUTER WORKSTATION QUESTIONNAIRE.

VIII. SUMMARY OF CHAPTER I

Chapter I presented the basic problem of workers using inadequate equipment or ergonomically incorrect equipment daily in their computer workstations. In order to perform an accurate survey of workstation assessments, a proactive organization with insight to current problems and concerns, as well as a genuine concern for the safety and health of its employees was needed to participate in this study. To this end, the United States Department of Energy, Oak Ridge Operations Division agreed to participate and allow the use of the assessment data.

Major limitations of the study were that only office workstations initially assessed were used, employees might not want to disclose information regarding signs and symptoms, and some employees might create signs and symptoms related to work activities to receive new equipment. The study was delimited to initial ergonomic assessments of computer workstations and grouping respondents by department, sex, and pain identification only; thereby maintaining confidentiality.

A brief history of ergonomics and an introduction to cumulative trauma disorders and carpal tunnel syndrome are presented in Chapter II. An explanation of the approach

followed and used in conducting this study is presented in Chapter III. The results of the study are shown in Chapter IV, and Chapter V summarizes the findings and presents conclusions and recommendations resulting from the study.

CHAPTER II

REVIEW OF THE LITERATURE

I. INTRODUCTION

In order to gain an understanding of ergonomics and how it can be applied to problems in today's computer workstations, a review of the literature on the history of ergonomics, human factors engineering, ergonomic draft standards, cumulative trauma disorders, and carpal tunnel syndrome was conducted.

II. HISTORY OF ERGONOMICS

A Polish educator and scientist, Wojciech Jastrzebowski has been given credit for introducing the term *ergonomics* into the literature in the 1860s. He is remembered as a prominent professor of natural sciences at the Agronomical Institute in Warsaw-Marymount, who was instrumental in creating the basis for the study of work in labor science (Polish Ergonomics Society, 1979) (Eastman Kodak Company, 1983).

The term *ergonomics* comes from the Greek word "ergos" meaning work and "nomos" meaning laws (Arndt, 1991). A quote from David C. Alexander, P.E. in his book, The Practice and Management of Industrial Ergonomics stated, "Ergonomics has its origins in the United Kingdom when "ergo" (work) was joined with "nomics" (the study of)" (Alexander, 1986). This is in part a falsity because there is documented evidence that the term was introduced by Wojciech Jastrzebowski in the 1860s (Polish Ergonomics Society, 1979) (Eastman Kodak Company, 1983); however, a formal definition of *ergonomics* was given in the United Kingdom in 1950. This formal definition was, "the study of human characteristics for the appropriate design of the living and work environment" (The National Safety Council, 1992).

The field of ergonomics was relatively quiet until World War II, when technology brought about complexity in aircraft, radar, and other equipment, significantly decreasing operator performance (Chapanis, 1951) (Eastman Kodak Company, 1983). Although a multidisciplinary approach to solving problems in engineering, behavior, and training was taken, bringing together psychologists, engineers, anthropologists, and physiologists, these early efforts were described as *human engineering* and *engineering psychology* and not identified as ergonomics until years later (Eastman Kodak Company, 1983).

"As interest in ergonomics grew, societies supporting the profession developed. The first known society that was formed to bring together the various disciplines concerned with people at work and to further the research effort was the Ergonomics Research Society of Great Britain (Edholm and Murrell, 1973) (Eastman Kodak Company, 1983). This society was formed in 1950, with the term *ergonomics* independently reinvented by Professor K.F.H. Murrell. In 1961 the first national meeting of what was to become known as the International Ergonomics Association was held in Stockholm, Sweden. Today, the association has at least fifteen affiliated societies including those in the United States, Great Britain, most European countries, Scandinavia, Japan, and Australia" (Eastman Kodak Company, 1983).

The goal of an ergonomics program is to reduce or eliminate ergonomic hazards in the workplace which may lead to cumulative trauma disorders or other related illnesses (OSHA, 1994). According to the National Office Products Association, "the most basic principle of ergonomics is designing the work environment to meet the needs of the worker" (Arndt, 1991).

III. HUMAN FACTORS ENGINEERING

The term *human factors engineering* is often used synonymously with the term *ergonomics*. "Human factors engineering is the 'discipline concerned with designing equipment so that people can use [it] effectively and safely, and creating environments suitable for human living and work'. Stated more simply, it is design based on human characteristics" (Huchingson, 1981)(Gilmore, et al., 1989).

In The Practice and Management of Industrial Ergonomics, Alexander describes the difference between ergonomics and human factors engineering. "There is a disagreement on the proper terminology to use to describe this field of study. Some prefer the words *human factors* or *human factors engineering*, feeling that the consideration of the human factor best describes this area. Still others choose the terms *bioengineering*, *biomechanics*, *human engineering*, or *engineering psychology* to describe their work. Although the term *ergonomics* is more widely used in Europe, *human factors* was the common terminology in the United States as recently as ten years ago. Now, however, *ergonomics* is being used to describe many efforts that arise from industry, but work within the transportation and

defense communities continues to be labeled *human factors* " (Alexander, 1986).

Further, "human factors engineering applies what is known about human characteristics and behavior to equipment, facilities, and environments in a systematic manner" (Gilmore, et al., 1989) and "the science of ergonomics seeks to adapt the job and workplace to the worker by designing tasks within the workers capabilities and limitations" (OSHA, 1994).

IV. ERGONOMIC DRAFT STANDARDS

The most prominent Ergonomic Draft Standard is currently OSHA's Ergonomics Program Management Recommendations for General Industry. Its origin stems from the demand that effective programs be implemented to protect workers from ergonomic hazards and from the dramatic increase in cumulative trauma disorders (CTDs) and other workplace illnesses due to ergonomic hazards (OSHA, 1994). The American National Standards Institute (ANSI) has the second revised discussion draft of ANSI Z-365 available for perusal. This is ANSI's proposed ergonomics standard (CTD News, 1994).

Ergonomic standards are not unique to the United States. In fact, "92 countries currently have ergonomics

laws or are preparing them", according to the presentation made by Dr. Jan Dul at the International Ergonomics Association triennial meeting held in August, 1994, in Toronto, Canada (CTD News, 1994). Dr. Dul, who is the deputy head of the TNO division of Working Environment and Health in Leiden, The Netherlands stated, "The rapid increase in the number of standards coincides with the greater impact (of cumulative trauma disorders) on society" (CTD News, 1994). "Of the 92 standards, 20 rules or drafts cover information presentation and communication, 24 cover video display terminals, 17 cover VDTs and thermal stress and eight encompass general ergonomics" (CTD News, 1994).

VI. CUMULATIVE TRAUMA DISORDERS AND CARPAL TUNNEL SYNDROME

"Cumulative trauma disorder (CTD) is the term used for health disorders arising from repeated biomechanical stress due to ergonomic hazards. Other terms used for such disorders include *repetitive motion injury*, *occupational overuse syndrome*, and *repetitive strain injury*. CTDs are a class of musculoskeletal disorders involving damage to the tendons, tendon sheaths, synovial lubrication of the tendon sheaths, and the related bones, muscles, and nerves of the hands, wrists, elbows, shoulders, neck, and back" (OSHA,

1994). Table II-1 lists typical risk factors for cumulative trauma disorders (OSHA, 1994).

One of the most frequently diagnosed CTDs is carpal tunnel syndrome, which is most commonly caused by chronic median nerve compression in the carpal canal (Rosenbaum and Ochoa, 1993). According to Clifford Posman, M.D., an orthopedic surgeon at the Methodist Medical Center in Oak Ridge, Tennessee, "Carpal tunnel syndrome is a problem of epidemic proportions particularly among patients working in jobs requiring repetitive use of their hands. It usually develops gradually over a period of months to years during which symptoms increase in intensity. Patients often complain of pain, numbness, or tingling in their hands which often wakes them up. The diagnosis of carpal tunnel syndrome is usually straight forward" (Posman, 1993). Table II-2 presents the duration of symptoms of carpal tunnel syndrome prior to diagnosis (Data from Phalen, 1966) (Rosenbaum and Ochoa, 1993). Table II-3 presents the age distribution of incidence of carpal tunnel syndrome in the citizens of Rochester, Minnesota (Data from Stevens, et al., 1988) (Rosenbaum and Ochoa, 1993).

"Carpal tunnel syndrome (CTS), a repetitive motion disorder, strikes 23,000 workers each year, and it is estimated that one in 10 Americans will eventually develop CTS. The National Institute for Occupational Safety and Health (NIOSH) reports that non-surgical treatment of the

TABLE II-1

TYPICAL RISK FACTORS FOR CUMULATIVE TRAUMA DISORDERS

• Excessive repetition/prolonged activities
• Forceful exertions, usually with the hands
• Pinch grips
• Prolonged static postures of the body, trunk and/or its extremities
• Awkward postures of the upper body, including reaching above the shoulders or behind the back
• Excessive bending or twisting of the wrist
• Continued elevation of the elbow
• Continued physical contact with work surfaces: e.g., contact with edges of machines
• Temperature extremes
• Inappropriate or inadequate hand tools
• Restrictive Workstations - inadequate clearances
• Vibration from power tools
• Improper seating/support

(Data from OSHA, 1994)

TABLE II-2
SYMPTOM DURATION IN YEARS PRIOR TO DIAGNOSIS

YEARS	PERCENTAGE OF PATIENTS
< 0.5	 30%
.05 - 2	 23%
2 - 10	 27%
10 - 20	 9%
> 20	 6%

(Data from Phalen 1966) (Rosenbaum and Ochoa, 1993)

TABLE II-3
AGE DISTRIBUTION OF INCIDENCE OF CARPAL TUNNEL SYNDROME
IN THE CITIZENS OF ROCHESTER, MINNESOTA

AGE IN YEARS	CASES OF CARPAL TUNNEL SYNDROME PER 100,000 POPULATION
0 - 14	. 0.3
15 - 24	 24
25 - 34	 91
34 - 44	 139
45 - 54	 266
55 - 64	 254
65 - 74	 221
75 - 84	 196
85+	 193

(Data from Stevens et al. 1988) (Rosenbaum and Ochoa, 1993)

average case of carpal tunnel syndrome costs \$3,500 in benefits and rehabilitation and can cost as much as \$30,000 if surgery is required - as it is in 100,000 cases each year" (Shafer, 1993).

Dr. John C. Shafer, Ph.D., author of the article, *When Your Job's A Pain In The Hand*, in the March, 1993 edition of *The Secretary* wrote, "One of the more alarming facts about CTS is that, because of the musculoskeletal strain from repeatedly flexing the wrist or applying arm-wrist-finger force does not cause observable injuries, it often takes months or years to detect damage. Often, the first complaint is of a painful tingling in one or both hands at night - 'nocturnal numbness' - sufficient to wake someone after a few hours of sleep. Since these symptoms occur at night, many people do not associate them with their jobs" (Shafer, 1993).

"According to the Social Security Administration's National Council on Compensation Insurance, workers submitted more than 125,000 CTS (carpal tunnel syndrome) related claims in 1990 alone - and the number continues to grow. The National Institute of Occupational Safety and Health (NIOSH) predicts that a full 50 percent of the workforce could suffer from repetitive motion injuries, such as CTS, by 2000" (*The Secretary*, 1993). "The U.S. Bureau of Labor Statistics cites CTS as the leading cause of occupational illness in the United States. This is no small

concern for American business. Computer-related absenteeism and workers' claims are said to exceed \$27 billion annually - and are growing" (*The Secretary*, 1993).

Many companies are now taking CTDs seriously. "Departing from the industry's general position that there is no definitive, scientific proof linking use of keyboards and cumulative trauma disorders, Compaq Computers and Microsoft Corp. announced they will place warning labels on their keyboards to increase 'awareness' of the CTD potential" (*CTD News*, 1994). The Microsoft Corp. warning label is quite specific and lengthy, whereas the Compaq Computers label is vague and short; however, both of these labels show a positive move in the prevention of CTDs.

VII. SUMMARY OF CHAPTER II

This chapter reviewed the history of ergonomics, human factors engineering, cumulative trauma disorders, and carpal tunnel syndrome. A review of Draft Ergonomic Standards revealed two American standards, the OSHA Draft Ergonomics Program Management Recommendations for General Industry and the ANSI Z-365 proposed ergonomic standard. Anthropometrics are necessary in design but, do not create an ergonomically correct condition alone. Ergonomics and human factors engineering are closely related; however, ergonomics is the

term most frequently used in relation to industry, and it has recently come to the forefront because of the increase in cumulative trauma disorders.

"The National Institute of Occupational Safety and Health predicts that a full 50 percent of the workforce could suffer from repetitive motion injuries, such as CTS by 2000" (The Secretary, 1993). To prevent this prediction from becoming reality, the proposed standards must give specific preventative guidance to industry and must be strictly enforced to protect the safety and health of the workforce.

CHAPTER III

METHODS AND PROCEDURES

I. INTRODUCTION

"Although an Advanced Notice for Proposed Rulemaking was published in the Federal Register on August 3, 1992, a general industry standard is not expected for the next five years. In the interim, guidelines are necessary to ensure uniform enforcement" (Occupational Safety & Health Reporter, 1993). "While all office work settings can benefit from the proper application of ergonomics, there are no set rules which can be applied across the board" (Arndt, 1991). Hence, the need for a streamlined approach to determine if workers are indeed experiencing symptoms and pain due to ergonomic factors. One of the bonafide ways to assess the needs of workers and determine if they are experiencing signs and symptoms is through the use of a survey technique.

II. INSTRUMENTATION

The selection of items for the COMPUTER WORKSTATION QUESTIONNAIRE was made based on guidance from the "OSHA BOSTON REGIONAL OFFICE INSTRUCTION TO INSPECTORS PROVIDING GUIDANCE AND PROCEDURES FOR ERGONOMIC INSPECTIONS", January 6, 1993 (Occupational Safety & Health Reporter, 1993).

The data received from this survey were to be factual in nature; thereby validating the survey instrument. No opinions were to be solicited from any of the survey respondents. The statements asked on the COMPUTER WORKSTATION QUESTIONNAIRE required either yes, no, multiple choice, or definite answers. Examples of definite answers include name, height, sex, and leg clearance height.

The COMPUTER WORKSTATION QUESTIONNAIRE was divided into four parts which included personal data, work characteristics, symptoms or problems, and work station. The development of the Initial Instatement phase of the study required three separate steps:

1. To review and revise the COMPUTER WORKSTATION QUESTIONNAIRE.
2. To perform ergonomic assessments on all employees/respondents between October 3, 1994

and November 4, 1994 (a five week period),
who had not been previously assessed.

3. To tabulate the final results of the survey.

Step 1. The COMPUTER WORKSTATION QUESTIONNAIRE was reviewed for possible improvement. The only revision made to the COMPUTER WORKSTATION QUESTIONNAIRE was the addition of DATE OF BIRTH, which was needed to calculate age in PART I - PERSONAL DATA.

Step 2. Over a five week period beginning October 3, 1994 and ending November 4, 1994, assessments were performed on 177 employees and their computer workstations. To determine who would be assessed, a list of all employees who had participated in previous ergonomic assessments was generated from the Ergonomics Database. Next, a personnel list, containing the names of all employees, was reviewed and the names of those who had previously participated in ergonomic assessments were removed. The remaining employees were further limited to employees working in the Federal Office Building. All employees remaining on the list were contacted and assessed by completion of the statements on the COMPUTER WORKSTATION QUESTIONNAIRE.

The COMPUTER WORKSTATION QUESTIONNAIRE data was then entered into the Ergonomics Database. This database was created for use by the United States Department of Energy, Oak Ridge Operations Division by Analysas, Inc. The primary

functions of this database were to store each individual ergonomic assessment and provide a means of useful data reporting. The Ergonomic Database created a new record in the data table for each individual assessed. Each statement was set up as a field and had a specific response. The Ergonomic Database also had an AD HOC QUERY capability which allowed specific reports to be generated on the basis of selected fields chosen by the report generator and the generator's security access level.

Step 3. The AD HOC QUERY capability was used to group the respondents on the basis of department, sex, and pain identification. After this initial grouping was completed, reports regarding signs and symptoms were generated. A complete copy of the COMPUTER WORKSTATION QUESTIONNAIRE may be found in Appendix A. Copies of the AD HOC QUERY reports generated may be found in Appendix B.

III. STATISTICAL DESIGN

The method for fulfilling the purposes of this study was to perform ergonomic assessments on all employees in the United States Department of Energy, Oak Ridge Operations Division at the Federal Building who had not previously been assessed. The predominant question within the survey was, "Do the individuals being assessed have ergonomic problems?"

The survey respondents were asked to render answers to the statements on the COMPUTER WORKSTATION QUESTIONNAIRE. These statements were in either yes or no or multiple choice or definite answer form. Examples of definite answers include name, height, sex, and leg clearance height. Using the Ergonomics Database program developed by Analysas, Inc., data was collected and entered in Microsoft Excel for Windows, Version 5.0., which was used to perform the statistical calculations.

Microsoft Excel for Windows, Version 5.0 is a powerful spreadsheet application for Microsoft Windows. It presents data in spreadsheet or matrix form, performs statistical analysis of data, creates charts with the Chart Wizard, and allows the user to customize data.

Each cell is at the intersection of row and a column and has its own unique address, which is commonly called a reference. Data is entered into the cells through the use of a keyboard, or a combination of the keyboard and mouse. The user may enter numerical data or alphabetical data in the cells; however, the statistical calculations for alphabetical data is limited to counting and summation. Specific information such as column headings may be entered for customization. Formulas are then entered by using specific cell references along with the proper worksheet function, such as SUM, COUNTA, MAX, MIN, STDEV, and VAR. The Microsoft Excel User's Guide provides specific

information to aid the user in customizing the data, and using special tool bars and functions (Microsoft Corporation, 1993).

IV. SUMMARY OF CHAPTER III

The most difficult task in this study was preparing the information from the Ergonomics Database for Microsoft Excel for Windows, Version 5.0. This chapter has presented a discussion on the steps required to prepare the COMPUTER WORKSTATION QUESTIONNAIRE, the selection of respondents, and the AD HOC QUERY capability used to formulate reports used for Microsoft Excel for Windows, Version 5.0.

The chapter included a brief discussion of Microsoft Excel for Windows, Version 5.0, which was used to perform the statistical calculations. Chapter four presents the results of the study.

CHAPTER IV

PRESENTATION AND DISCUSSION OF RESULTS

I. INTRODUCTION

This chapter presents the assessment results from the COMPUTER WORKSTATION QUESTIONNAIRE. It also includes a discussion of the statistical results from Microsoft Excel for Windows, Version 5.0. The matrices created from Microsoft Excel for Windows address eight questions from the COMPUTER WORKSTATION QUESTIONNAIRE, which are of primary importance for this study. These questions are the basis for the data presented as tables in this section.

II. SUMMARY OF COMPUTER WORKSTATION QUESTIONNAIRE RESPONSES

The COMPUTER WORKSTATION QUESTIONNAIRE was used to conduct 177 assessments. The data received from this survey were factual in nature. No opinions were solicited from any of the survey respondents. The statements asked on the COMPUTER WORKSTATION QUESTIONNAIRE required either yes, no, multiple choice, or definite answers.

To assure confidentiality and sequence survey data to keep the answers of each respondent in the same location on each report, the respondents were grouped by department, sex, and pain identification. The COMPUTER WORKSTATION QUESTIONNAIRE is shown in Appendix A. The final reports, which were created using the AD HOC QUERY capability from the Ergonomics Database, are presented in Appendix B. Microsoft Excel for Windows, Version 5.0 was used to statistically organize the data used on eight questions for this study. The matrices created in Microsoft Excel are shown in Appendix C, Appendix D, and Appendix E.

III. INFORMATION RECEIVED FROM THE COMPUTER WORKSTATION QUESTIONNAIRE

Assessments were conducted on 177 employees of the United States Department of Energy, Oak Ridge Operations Division. Questions asked were based on the following categories: personal data, work characteristics, symptoms or problems, and work station.

As Table IV-1 indicates, 106 or 60% of the employees surveyed experienced signs and symptoms related to work activities. Only 16 or 9% of employees were receiving treatment. Employees who participated in outside work

TABLE IV-1

SUMMARY YES/NO RESPONSES

QUESTION	YES	NO
Do you have signs and and symptoms related to your work activities?	60%	40%
Are you receiving treatment?	9%	91%
Do you participate in outside work activities that may be strenuous or involve repetitive motion?	41%	59%

activities which were strenuous or repetitive in motion totaled 72 or 41%. Recommendations were made for each of the 177 employees surveyed in this study, ranging from rearranging the workstation or ordering new office equipment to staggering the work routine.

Table IV-2 shows results grouped by sex. These data were presented to reveal the relationship between signs and symptoms and the sex of the respondent. Also presented in this table, was information that identified daily work at the computer as continuous or intermittent. The work at the computer was important to determine if there was a pattern between signs and symptoms and intermittent work or continuous work. Table IV-2 shows that females had more signs and symptoms than males, and their work was more intermittent than continuous. Of the females suffering from signs and symptoms, only eight of them performed work on a continuous basis at their computer workstations.

Table IV-3 shows the relationship between respondent age and signs and symptoms. A graphic representation of the data from Table IV-3 is presented in Table IV-3A. These data were instructive in revealing if one certain age group suffered signs and symptoms more than another. Conversely, it was also important to illustrate if one age group did not suffer from signs and symptoms in relation to the other groups. Table IV-3 revealed that the age group of 41 to 50 years old had the highest incidence of signs and symptoms.

TABLE IV-2
DATA RESULTS GROUPED BY SEX

RESPONDENT SEX	SIGNS & SYMPTOMS = YES	WORK AT COMPUTER C or I where S&S = YES	SIGNS & SYMPTOMS = NO	WORK AT COMPUTER C or I where S&S = NO
Male	42	C = 7 I = 35	40	C = 11 I = 29
Female	64	C = 8 I = 56	31	C = 0 I = 31
TOTALS	106	C = 15 I = 91	71	C = 11 I = 60

Legend: C = Continuous work
I = Intermittent work

TABLE IV-3**DATA RESULTS GROUPED BY AGE AND SIGNS & SYMPTOMS RESPONSE**

RESPONDENT AGES	S & S = YES	S & S = NO	AGE GROUP TOTALS
0-20	3	2	5
21-30	14	11	25
31-40	27	13	40
41-50	32	26	58
51-60	24	16	40
61-70	4	3	7
71 +	2	0	2
TOTALS	106	71	177

However, this age range also had the highest incidence of not having signs and symptoms. The median age in this survey was 43 and the majority of respondents were in this age category (41 to 50 years old), specifically 58 of the 177 respondents surveyed were in this age range. The other age groups were similarly closely related in age for those having signs and symptoms and those not having signs and symptoms.

Table IV-4 shows results grouped by degree of effect of signs and symptoms, which was either none, minimal, reduced work efficiency, or lost time. This table revealed the greatest effect, in both respondents having signs and symptoms and those not having signs and symptoms, was none. Of those respondents having signs and symptoms, 35 suffered minimal effects, and 2 suffered lost work efficiency. None of the respondents suffering from signs and symptoms lost time at work.

Table IV-5 shows results grouped by daily time spent at the computer and signs and symptoms. The most frequent rate of daily time spent at the computer was 4 to 8 hours. This rate accounted for 50 of the 177 respondents, or 76% of those respondents experiencing signs and symptoms. Similarly, 0 to 2 hours was the most frequent rate of daily time spent at the computer for those respondents not suffering from signs and symptoms. This rate accounted for 37 of the 177 respondents, or 58% of those respondents not

TABLE IV-4**DATA RESULTS GROUPED BY DEGREE OF EFFECT OF SIGNS & SYMPTOMS**

SIGNS AND SYMPTOMS RESPONSE	EFFECT = None	EFFECT = Minimal	EFFECT = Reduced Work Efficiency	EFFECT = Lost Time
Yes	69	35	2	0
No	71	0	0	0
TOTALS	140	35	2	0
TOTAL AS A PERCENTAGE OF ALL SURVEY RESPONDENTS	Y = 49% N = 51%	Y = 100% N = 0%	Y = 100% N = 0%	N/A

TABLE IV-5
DATA RESULTS GROUPED BY DAILY TIME SPENT AT COMPUTER AND
SIGNS & SYMPTOMS

SIGNS AND SYMPTOMS RESPONSE	DAILY TIME SPENT AT COMPUTER in hrs. (0-2)	DAILY TIME SPENT AT COMPUTER in hrs. (2-4)	DAILY TIME SPENT AT COMPUTER in hrs. (4-8)
Yes	27	29	50
No	37	18	16
TOTALS	64	47	66
TOTAL AS A PERCENTAGE OF ALL SURVEY RESPONDENTS	Y = 42% N = 58%	Y = 62% N = 38%	Y = 76% N = 24%

suffering from signs and symptoms related to their work activities. These data reveal an important relationship between daily time spent at the computer and signs and symptoms relating to work activities. In effect, the study showed that greater the time periods spent at the computer created a greater likelihood of the respondent suffering from signs and symptoms.

Microsoft Excel for Windows, Version 5.0 was used to generate the matrices found in Appendix C, Ergonomics Survey Data And Statistics, Appendix D, Respondents With Pain & Symptoms, and Appendix E, Respondents With No Pain & Symptoms. These matrices present a listing of the eight questions from the COMPUTER WORKSTATION QUESTIONNAIRE, which were used in an attempt to provide some insight to the survey problem, and provide data which may possibly answer the five proposed research questions.

The following is a summary of the research questions, accompanied by the answers, according to the survey data from the COMPUTER WORKSTATION QUESTIONNAIRE. The essence of the research problem was to determine:

Question 1: Does the employee suffer from pain or symptoms related to work activities?

Response: Yes. This survey revealed 106 employees, or 60% of the respondents surveyed, suffer from pain or

symptoms related to work activities. Conversely, 71 employees, or 40%, did not have pain or symptoms related to their work activities. Some respondents indicated pain due to outside causes or illnesses; however, signs and symptoms due to outside causes were not included in the signs and symptoms category. For the purposes of this survey, only signs and symptoms related to work activities were included in this category. The signs and symptoms suffered included pain, aching, tingling, and/or numbness.

Question 2: Can recommendations be made to better the computer workstation ergonomically for the employee?

Response: Yes. Recommendations were made for 100%, or each of the 177 employees surveyed in this study. Examples of recommendations made included re-arranging the workstation, ordering new office equipment, and staggering the work routine. Some of the employees had ergonomically correct equipment, while others were still working with outdated equipment. The specific equipment recommendations were noted in the Recommendation Section on page two of the initial survey instrument. Other specific recommendations such as staggering the work routine were written in the

Recommendation Comments section, which was also on page two.

Question 3: Does the employee spend more than 4 hours at the computer daily?

Response: Yes, but only by a small margin. Out of the total number of employees surveyed, 66 or 37% spend from 4-8 hours daily at their computer. The total for those who spend from 2-4 hours daily at their computer was 64 employees or 36%, and the remaining 47 employees or 27% spend from 0-2 hours daily at their computer. The most frequent rate of daily time spent at the computer was 4 to 8 hours, which accounted for 50 of the 177 respondents, or 76% of those respondents experiencing signs and symptoms.

Question 4: If the employee has signs and symptoms, have they affected work performance?

Response: No. Although 106 employees, or 60% of the respondents surveyed, suffered from pain or symptoms related to work activities, these signs and symptoms did not affect their work to a great extent. Appendix D shows the answers of respondents suffering from signs and symptoms. Out of the total number of employees

with signs and symptoms, 69 employees or 65% answered "none", 35 employees or 33% answered "minimal", and two employees or 1% answered "reduced work efficiency". None of the respondents lost time from work due to signs and symptoms.

Question 5: If the employee has signs and symptoms, does the employee participate in outside/off work activities that may be strenuous or involve repetitive motion?

Response: No, but only by a small margin. Although 56 employees or 53% answered "no", 50 employees, or 47% answered "yes". The numbers for employees who did not participate in outside activities, which were repetitive in motion, were only slightly higher than those employees who did participate in repetitive motion activities. Employees who answered yes to this question cited repetitive activities such as golfing, running, tennis, sewing, and knitting. This data failed to indicate overall that repetitive motion activities outside work might also contribute to signs and symptoms.

CHAPTER V.

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The primary purpose of this study was to survey the possible need for and functions of computer workstation assessments in the office workstations at the United States Department of Energy, Oak Ridge Operations Division at the Federal Building. The secondary purpose was to establish the need for efficiency through these assessments. The motivation for this study was the review of the OSHA Draft Standard "Ergonomics Program Management Recommendations For General Industry", the rising concerns regarding ergonomics as a hot topic in current events, and the opportunity to assess employees at DOE ORO. Chapter II confirmed the presence of ergonomics and human factors engineering before this decade, while confirming the need for concern. Chapter III presented a discussion on the steps required to prepare the COMPUTER WORKSTATION QUESTIONNAIRE, the selection of respondents, and the AD HOC QUERY capability used to formulate data reports used by Microsoft Excel for Windows, Version 5.0 to perform statistical calculations. Chapter IV

presented results from the COMPUTER WORKSTATION QUESTIONNAIRE, using eight questions, in an attempt to provide some insight to the research problem, and provide data which would possibly answer the five proposed research questions.

II. FINDINGS

An analysis of the eight specific questions from the COMPUTER WORKSTATION QUESTIONNAIRE showed that:

1. Signs and symptoms related to work activities were indicated by 106 employees or 60% of those surveyed.
2. Of those employees indicating signs and symptoms, it did not affect work for 79%, affected work minimally for 20%, reduced work efficiency for 1%, and did not result in any lost time injuries.
3. The majority of employees work 4 to 8 hours daily at their computer workstations, exhibiting the highest incidence of signs and symptoms related to their work activities.

4. Both young and old reported having signs and symptoms, which discounted age as a factor for indicating signs and symptoms.
5. Respondents between the ages of 41 and 50 years old had the highest rates of incidence in both suffering from signs and symptoms and not suffering from signs and symptoms related to work activities.
6. Continuous work was not found to indicate a high number of respondents with signs and symptoms.
7. Female respondents performing intermittent work had the highest occurrence of signs and symptoms.

III. CONCLUSIONS

The conclusions drawn from the study were:

1. Overall, there is a need for ergonomic assessments of computer workstations. This statement is made based on the fact that 60% of the respondents surveyed, suffer from pain or symptoms related to work activities, indicating a problem in well over half of the survey population.

2. It was concluded that age was not a significant factor in determining signs and symptoms related to work activities. Appendix D shows results of those respondents with signs and symptoms and Appendix E shows the results of those respondents with no signs and symptoms. In each of the above-mentioned appendices, the maximum age was above 70 years, the minimum age was below 21, and the average age was 43 in both. This data shows no relationship between age and the occurrence of signs and symptoms related to work activities.

3. It was determined that continuous work was not directly responsible for signs and symptoms. This conclusion was based on the fact that continuous work was noted only in 15% of the total survey respondents and in 14% of the respondents with signs and symptoms.

4. It was concluded that participation in outside activities which may be strenuous or repetitive in motion was not a significant factor in those respondents with signs and symptoms. Fifty three percent of the respondents with signs and symptoms did not participate in outside activities, and forty-seven percent did participate in outside activities. It is interesting to note that 31% of the respondents with no signs and symptoms did participate in outside activities, and 69% did not.

IV. RECOMMENDATIONS

This study revealed that over half of the employees in the survey population suffer from signs and symptoms related to their work activities and identified the need for ergonomic assessments in the office workstation.

Recommendations were made for each respondent surveyed. In each case, improvements were suggested to eliminate ergonomic hazards. Some employees had ergonomically correct equipment and were not utilizing it properly, while others were operating with older equipment. Ergonomic equipment must be used properly in order to mitigate ergonomic hazards. This signifies a need to educate employees in proper ergonomic practices for their office workstations. It is hoped that companies will be proactive in their approach to employee safety and health, implementing an ergonomic assessment program on their office workstations, and in all of their work areas to identify other ergonomic hazards that may exist.

Specifically, it is recommended that OSHA issue its Draft Standard "Ergonomics Program Management Recommendations For General Industry" in a timely manner, to provide guidance for industry for the implementation of ergonomic assessment programs. In an article titled,

"Americans Oppose Ergonomics Standard, Industry Poll Finds", in the Stevens OSHA Reporter OSHAWeek for July 3, 1995, The Tarrence Group randomly selected 1,000 registered voters on May 10, 1995 to ask them where they believed OSHA should spend more resources. Repetitive Strain Injuries ranked 4th at 9%, after Reducing Accidental Deaths - ranked 1st at 52%, Secondhand Smoke - ranked 2nd at 13%, and Workplace Violence - ranked 3rd at 11%. When asked if they favored or opposed the implementation of an ergonomics standard, 53% were opposed and 39% were in favor of it. Many industries want more research before regulations are implemented; however, people are suffering from signs and symptoms due to their work activities now, and the trauma is cumulative.

In closing, there is no current standard in effect to force industry to perform ergonomic assessments on individual computer workstations; however, many companies and governmental agencies are proactive and want to mitigate potential ergonomic hazards which may adversely affect the health of their employees. It is an opinion that a general ergonomic education program would greatly benefit all employees who perform work at computer workstations. The benefits of such a program would far outweigh the initial cost of the program design.

SELECTED BIBLIOGRAPHY

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1. "92 Countries Have Ergo Rules Or Drafts." CTD News. September, 1994. p.3.
2. Alexander, David C., P.E. 1986. The Practice And Management Of Industrial Ergonomics. Englewood Cliffs, NJ: Prentice-Hall, Inc. pp. 3, 131-134.
3. Arndt, Robert, Ph.D. 1991. Ergonomics and Office Design. Alexandria, VA: National Office Products Association. pp.1-3.
4. Associated Press. 1994. "Rules on 'repetitive motion' injuries face probable delay." The Knoxville News-Sentinel, Saturday, November 5, 1994.
5. Bureau of Labor Statistics. Release date: Wednesday, November 18, 1992. News. Washington, D.C.: United States Department of Labor. p.2.
6. Carter, C.N. December 1994. What Basic Knowledge Is Needed In Order To Become A Certified Crane Inspector. Knoxville, TN: University of Tennessee.
7. Chapanis, A. 1951. "Theory and Methods of Analyzing Errors in Machine Systems." Annals of the New York Academy of Science, 51. pp. 1179-1203.
8. "Compaq, Microsoft put CTD Warnings on keyboards." CTD News. September, 1994. p.1.
9. Eastman Kodak Company: Human Factors Section. 1983. Ergonomic Design for People at Work. Vol.1; Belmont, CA: Lifetime Learning Publications. pp. 3-5.
10. Edholm, O.G., and K.F.H. Murrell. 1973. The Ergonomics Research Society, A History 1949-1970. London: Ergonomics Research Society, 39 pages.
11. Gilmore, Walter E., David I. Gertman, and Harold S. Blackman. 1989. The User-Computer Interface in Process Control A Human Factors Engineering Handbook. San Diego, CA: Academic Press, Inc. pp. 4, 259.

12. Harman, H.H. 1976. Modern Factor Analysis, Third Edition; Chicago: University of Chicago Press.
13. Huchingson, R.D. 1981. New Horizons for Human Factors in Design. New York, NY: McGraw-Hill Book Co.
14. Microsoft Corporation. 1993. Microsoft Excel User's Guide, Version 5.0.
15. "Newsletter Focuses of Computer-Related Illnesses." Random Input. The Secretary. October, 1992. p.7.
16. The National Safety Council. 1992. Accident Prevention Manual for Business & Industry, Engineering Technology, 10th edition; United States of America: The National Safety Council. p.103.
17. Occupational Safety and Health Administration (OSHA). 1994. Draft Standard "Ergonomics Program Management Recommendations For General Industry". pp. 2-4, 11, and the glossary.
18. "OSHA BOSTON REGIONAL OFFICE INSTRUCTION TO INSPECTORS PROVIDING GUIDANCE AND PROCEDURES FOR ERGONOMIC INSPECTIONS, January 6, 1993." Occupational Safety & Health Reporter. October 13, 1993. pp.582-603.
19. Phalen, G.S. 1966. "The carpal-tunnel syndrome. Seventeen years' experience in diagnosis and treatment of six hundred fifty-four hands". J Bone Joint Surg 1966; 48A: 211-28.
20. Polish Ergonomics Society. 1979. Ergonomia 2 (1). 7th International Ergonomic Association Congress. A comprehensive study of this subject was also published by J. Banka in the book Narodying filozofil nauky a pracy, KiW, 1970.
21. Posman, Clifford, M.D. "Hand pain can lead to condition requiring release." The Oak Ridger. Sunday, January 3, 1993. p. 3D.
22. "Prevention Combats Carpal Tunnel Syndrome." Random Input. The Secretary. October, 1993.
23. Pringle, R.M., and A.A. Raynor. 1971. Generalized Inverse Matrices with Applications to Statistics. New York, NY: Hafner Publishing Co. pp. 230-463.

24. Rockwell, Cynthia. 1995. "Americans Oppose Ergonomics Standard, Industry Poll Finds". Stevens OSHA Reporter OSHAWeek. Washington, D.C. News Bureau. July 3, 1995. pp. 2 and 12.
25. Rosenbaum, Richard B., and Jose' L. Ochoa. 1983. Carpal Tunnel Syndrome and Other Disorders of the Median Nerve. Stoneham, MA: Butterworth-Heinemann. pp. 35, 36, 49, 251, and 271.
26. SAS User's Guide: Statistics, Version 5 Edition. 1985. SAS Institute Inc., Box 8000, Cary, NC.
27. Schafer, John C., Ph.D. "When Your Job's A Pain In The Hand." The Secretary. March, 1993. pp. 16-18.
28. Stevens JC, Sun S, Beard CM, O'Fallon WM, Kurland LT. 1988. "Carpal tunnel syndrome in Rochester, Minnesota, 1961 to 1980". *Neurology* 1988; 38: 134-38.
29. Tountas CP, MacDonald CJ, Meyerhoff JD, Bihrlle DM. 1983. "Carpal tunnel syndrome. A review of 507 patients". *Minn Med* 1983; 66: 479-82.

APPENDICES

APPENDIX A

DOE OAK RIDGE OPERATIONS COMPUTER WORKSTATION QUESTIONNAIRE	PART I PERSONAL DATA STATUS: NAME: _____ ROOM: _____ BUILDING#: _____ DEPT: _____ PHONE: _____ HEIGHT: _____ SEX: _____ ASSESSOR: _____ DATE: _____	
PART II WORK CHARACTERISTICS 1. Amount of time spent at computer daily: ☐ 0-2 ☐ 2-4 ☐ 4-8 2. Work at the computer: ☐ Continuous, infrequent breaks ☐ Intermittent, regular interruptions/breaks 3. How long have you used a computer in your work? ☐ 1-2 yrs ☐ 3-5 yrs ☐ 6-9 yrs ☐ >9 yrs	4. Is the same chair for other work areas used to: ☐ Read/Write at another desk ☐ Type (typewriter) Wrist Height: ☐ Other 5. Reviewed ErgoSmart within the last 6 months? Yes ☐ No 6. Prescription Lenses ☐ Yes ☐ No Contacts ☐ Yes ☐ No ☐ N ☐ F Focal: ☐ M ☐ B ☐ T Astigmatism: ☐ Yes ☐ No 7. Computer eye glasses: ☐ Yes ☐ No 8. Last eye exam: Years	
PART III SYMPTOMS OR PROBLEMS 1. Do you have any of the following pains/symptoms related to work activities? ☐ Yes ☐ No For Question #2, describe pain as: (P)ain, (S)tiffness, (A)ching, (T)ingling, and/or (N)umbness 2. Where? How Often? Describe as: Time of Day: Head Eyes Neck Arm Hand Back Leg Comments:	3. How has this pain affected work performance? ☐ None ☐ Minimal ☐ Reduced work efficiency (moderate) ☐ Lost work time, absence from work (significant) 4a. Are you receiving treatment for these symptoms? ☐ Yes ☐ No 4b. Reported to DOE Medical? ☐ Yes ☐ No 4c. OWCP? ☐ Yes ☐ No Doctors Comments: 5. Do you have other health problems that are aggravated by working conditions? ☐ Yes ☐ No 6. Do you participate in outside/off work activities that may be strenuous or involve repetitive motion? ☐ Yes ☐ No What are these outside activities?	
PART IV WORK STATION Computer is on a ☐ Table (standard) ☐ Desk (standard) ☐ Computer Table ☐ Rolling Module ☐ Modular Furniture Skirt? ☐ Yes ☐ No Leg Clearance height - Primary: Other: Inches Keyboard: ☐ On Desk/Table/Other ☐ Drawer under ☐ Articulating keyboard ☐ Other Key height (by 1/4in): Mouse used? ☐ Yes ☐ No At keyboard ☐ Yes ☐ No Appropriate reach ☐ Yes ☐ No Mouse rest ☐ Yes ☐ No Frequency - comments: Work surface: Sharp edges ☐ Yes ☐ No Different heights ☐ Yes ☐ No Adjustable ☐ Yes ☐ No Ergonomically organized ☐ Yes ☐ No MONITOR AND DOCUMENT HOLDER Monitor 18-24 in. (arms length) ☐ Yes ☐ No Document holder used? ☐ Yes ☐ No Bright lights/surfaces in operators line of sight? ☐ Yes ☐ No Work station between fixtures? ☐ Yes ☐ No Work station light level: Other surface: ft candles Windows: ☐ Behind VDT ☐ Right Angle ☐ Behind Operator ☐ None Shades/Curtains/Blinds ☐ Yes ☐ No Used? ☐ Yes ☐ No Anti-glare screen? ☐ Yes ☐ No ☐ N/A Comments:		
SEATING: Chair Features: Height adjustment ☐ Pneumatic ☐ Manual ☐ None Recline with adjustable tension ☐ Yes ☐ No Armrest: ☐ Full ☐ Half ☐ None Padded ☐ Yes ☐ No Adjustable ☐ Vertical ☐ Horizontal Lumber Support: ☐ Yes ☐ No ☐ N/A Adequate ☐ Yes ☐ No Adjustable ☐ Yes ☐ No High Back Support: ☐ Yes ☐ No ☐ N/A Adequate ☐ Yes ☐ No Adjustable ☐ Yes ☐ No Base: ☐ 5-leg ☐ Swivel ☐ Casters Seat Pan: ☐ Padded ☐ Front edge rounded ☐ Seat depth adjustable Chair meets ergonomic specifications ☐ Yes ☐ No Footrest ☐ Yes ☐ No ☐ N/A Comments:		PRIORITY:

**DOE OAK RIDGE OPERATIONS
COMPUTER WORKSTATION
QUESTIONNAIRE**

NAME:
ROOM:
DEPT:
HEIGHT:
ASSESSOR:

BUILDING#:
PHONE:
SEX:
DATE:

PART IV (CONTINUED)

POSTURE:

	Keyboard	Mouse
Forearm parallel to floor	☐ Yes ☐ No	☐ Yes ☐ No
Wrists in neutral position	☐ Yes ☐ No	☐ Yes ☐ No
Monitor in line with operator	☐ Yes ☐ No	☐ Yes ☐ No
Top of monitor at or below eye level	☐ Yes ☐ No	☐ Yes ☐ No
Knees slightly higher than hips	☐ Yes ☐ No	☐ Yes ☐ No
Feet firmly supported	☐ Yes ☐ No	☐ Yes ☐ No
Spine supported in 'S' curve	☐ Yes ☐ No	☐ Yes ☐ No
Twisting required to see monitor or work surface	☐ Yes ☐ No	☐ Yes ☐ No

Comments:

RECOMMENDATIONS: (✓ - Recommend * - Closed e - Exempted)

☐ Adjustable footrest	☐ Re-arrange workstation
☐ Chair IH Select? ☐ Yes ☐ No	☐ Staggered work routine
☐ Document holder with line indicator/adjustable	☐ Computer table, adjustable, in-stock
☐ Computer eyeglasses	
☐ Footrest	☐ Mouse wristrest
☐ Anti-glare screen	☐ Keyboard wristrest
☐ Articulating keyboard	☐ Typewriter wristrest
☐ Task lighting	☐ Lumbar support
☐ Modular furniture	☐ Seat wedge
	☐ Other:

RECOMMENDATION COMMENTS:

RESPONSE COMMENTS:

APPENDIX B

Assessments by Jamie Arnold

[illegible]

Assessments by Jamie Arnold					Act.	Treat
Assessor	Department	Sex	P & S Affects			
J. ARNOLD	AD-44	F	Minimal	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	None	F	T	
J. ARNOLD		F	Minimal	F	T	
J. ARNOLD		F	None	F	T	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	Minimal	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD	CC-10	M	Minimal	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD	CE-50 CE-52 DP-80	F	None	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD		F	None	F	F	
J. ARNOLD		F	None	T	F	
J. ARNOLD	EF-20	M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	None	F	F	
J. ARNOLD		M	Minimal	F	F	

Assessments by Jamie Arnold

[illegible]

Department Sex P & S Work at Computer

[illegible]

x P & S Work at Computer

[illegible]

Assessments by Jamie Arnold

Assessor	Department	Sex	P	S	Work at Computer	Time	Years
J. ARNOLD	SE-33	M	T		Intermittent, regular interruptions/breaks	2-4	3-5 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	2-4	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	4-8	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	0-2	1-2 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	2-4	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	4-8	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	4-8	6-9 yrs
J. ARNOLD	SE-34	M	T		Intermittent, regular interruptions/breaks	2-4	> 9 yrs
J. ARNOLD		F	F		Intermittent, regular interruptions/breaks	2-4	3-5 yrs
J. ARNOLD		F	F		Intermittent, regular interruptions/breaks	0-2	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	0-2	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	2-4	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	4-8	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	0-2	> 9 yrs
J. ARNOLD		M	T		Intermittent, regular interruptions/breaks	2-4	3-5 yrs

Total records printed: 177

APPENDIX C

APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work Options = None, Minimal, Reduced Wk. Eff. & Lost Time	Is Work at Computer Continuous or Intermittent? Options = T/F	Daily Time Spent at Computer in hours Options = (0-2), (2-4), (4-8)	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F		Options = T/F		Options = T/F	Options = T/F
1	F	T	Minimal	I	(0-2)	F	T
2	M	F	None	C	(0-2)	F	F
3	F	F	None	I	(2-4)	F	F
4	F	F	None	I	(4-8)	F	F
5	F	F	None	I	(0-2)	F	F
6	F	F	None	I	(4-8)	F	F
7	F	F	None	I	(0-2)	F	T
8	F	F	None	I	(4-8)	F	F
9	F	F	None	I	(0-2)	F	T
10	F	T	Minimal	I	(2-4)	F	F
11	F	T	None	I	(0-2)	F	T
12	F	T	None	I	(4-8)	F	F
13	F	T	None	I	(0-2)	F	F
14	F	T	None	I	(2-4)	F	F
15	F	T	Minimal	I	(4-8)	F	T
16	F	T	None	I	(0-2)	F	T
17	F	T	None	I	(0-2)	F	F
18	M	F	None	I	(0-2)	F	T
19	M	F	None	I	(0-2)	F	F
20	M	F	None	I	(0-2)	F	F
21	M	F	None	C	(0-2)	F	T
22	M	F	None	I	(0-2)	F	F
23	M	F	None	I	(0-2)	F	F
24	M	F	None	C	(0-2)	F	F
25	M	F	None	I	(0-2)	F	T
26	M	F	None	I	(0-2)	F	F
27	M	T	None	I	(0-2)	F	F
28	M	T	Reduced Wk. Eff.	C	(0-2)	T	F
29	F	F	None	I	(2-4)	F	F
30	F	T	None	I	(4-8)	F	T
31	M	F	None	I	(2-4)	F	F
32	M	T	Minimal	C	(4-8)	F	T

Age
Options = 19 - 74
58
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APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff. & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
Respondent Number							
33	F	F	None	I	(4-8)	F	F
34	F	F	None	I	(4-8)	F	F
35	F	F	None	I	(0-2)	F	T
36	F	F	None	I	(0-2)	F	F
37	F	F	None	I	(4-8)	F	F
38	F	F	None	I	(2-4)	F	F
39	F	F	None	I	(2-4)	F	F
40	F	F	None	I	(4-8)	F	F
41	F	F	None	I	(4-8)	T	F
42	F	F	None	I	(0-2)	F	F
43	F	F	None	I	(2-4)	F	F
44	F	T	None	I	(2-4)	F	F
45	F	T	Minimal	C	(4-8)	F	F
46	F	T	None	C	(4-8)	F	F
47	F	T	Minimal	I	(0-2)	F	T
48	F	T	None	I	(2-4)	F	F
49	F	T	None	I	(0-2)	F	F
50	F	T	Minimal	C	(4-8)	F	F
51	F	T	Minimal	C	(4-8)	T	T
52	F	T	Minimal	I	(2-4)	T	T
53	F	T	Minimal	I	(0-2)	F	F
54	F	T	Minimal	I	(2-4)	T	T
55	F	T	Minimal	I	(4-8)	F	F
56	F	T	None	I	(4-8)	F	T
57	F	T	Minimal	C	(4-8)	F	F
58	F	T	Minimal	I	(4-8)	F	F
59	F	T	Minimal	I	(4-8)	T	F
60	F	T	None	I	(4-8)	T	F
61	F	T	Minimal	I	(4-8)	F	T
62	F	T	None	I	(0-2)	F	F
63	F	T	None	I	(2-4)	F	F
64	F	T	Minimal	I	(4-8)	T	F
65	F	T	None	I	(0-2)	F	F
66	F	T	None	C	(4-8)	F	F
67	F	T	Minimal	I	(4-8)	F	T
68	F	T	Minimal	I	(4-8)	F	F

Age
Options = 19 - 74
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APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work Options = None, Minimal, Reduced Wk. Eff. & Lost Time	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours Options = (0-2), (2-4), (4-8)	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F		Options = T/F		Options = T/F	Options = T/F
Respondent Number							
69	F	T	Minimal	C	(4-8)	T	T
70	F	T	None	I	(4-8)	T	F
71	M	F	None	I	(0-2)	F	T
72	M	F	None	I	(4-8)	F	F
73	M	F	None	I	(0-2)	F	F
74	M	F	None	C	(0-2)	F	F
75	M	T	Minimal	I	(2-4)	T	F
76	M	T	None	I	(4-8)	F	T
77	M	T	None	I	(0-2)	F	T
78	M	T	None	I	(0-2)	F	F
79	M	T	None	I	(4-8)	F	T
80	M	T	None	I	(4-8)	F	T
81	M	T	None	I	(4-8)	F	F
82	F	F	None	I	(0-2)	F	F
83	F	T	None	I	(4-8)	F	F
84	M	F	None	I	(2-4)	F	F
85	M	T	None	I	(2-4)	F	F
86	F	T	None	I	(0-2)	F	T
87	M	T	None	C	(4-8)	F	T
88	F	F	None	I	(4-8)	F	T
89	F	T	Minimal	I	(4-8)	F	T
90	F	T	None	C	(4-8)	F	F
91	F	T	None	I	(4-8)	F	F
92	M	F	None	I	(0-2)	F	T
93	M	F	None	I	(0-2)	F	F
94	M	F	None	C	(4-8)	F	F
95	M	F	None	C	(4-8)	F	F
96	M	F	None	C	(4-8)	F	T
97	M	F	None	C	(4-8)	F	F
98	M	F	None	C	(4-8)	F	F
99	M	F	None	C	(4-8)	T	T
100	M	T	None	I	(0-2)	F	T
101	M	T	None	I	(0-2)	F	T
102	M	T	None	C	(4-8)	F	T
103	M	T	None	C	(4-8)	F	F
104	M	T	None	C	(4-8)	F	T

Age
Options = 19 - 74
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APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Is Work at Computer Continuous or Intermittent? Options = T/F	Daily Time Spent at Computer in hours Options = (0-2), (2-4), (4-8)	Receiving Treatment? Options = T/F	Do you participate in outside activities? Options = T/F
105	M	T	Minimal	C	(4-8)	F	F
106	F	F	None	I	(2-4)	F	F
107	M	F	None	I	(0-2)	F	T
108	M	F	None	I	(2-4)	F	T
109	F	T	Minimal	I	(2-4)	T	F
110	M	F	None	I	(2-4)	F	F
111	M	T	Minimal	I	(2-4)	F	T
112	M	T	None	I	(2-4)	T	F
113	M	T	None	I	(4-8)	F	F
114	F	F	None	I	(2-4)	F	F
115	F	F	None	I	(0-2)	F	F
116	F	F	None	I	(0-2)	F	T
117	F	T	None	I	(0-2)	F	F
118	F	T	Minimal	I	(0-2)	T	T
119	F	T	None	I	(4-8)	F	F
120	M	F	None	I	(0-2)	F	T
121	M	F	None	I	(0-2)	F	T
122	M	T	None	I	(0-2)	F	T
123	F	F	None	I	(0-2)	F	F
124	F	T	None	I	(0-2)	F	F
125	F	T	Minimal	I	(2-4)	F	T
126	F	T	None	I	(2-4)	F	F
127	F	T	None	I	(4-8)	F	T
128	F	T	None	I	(2-4)	F	F
129	F	T	Minimal	I	(4-8)	F	F
130	F	T	None	I	(4-8)	F	T
131	F	T	None	I	(4-8)	F	T
132	F	T	None	I	(2-4)	F	F
133	F	T	Minimal	I	(4-8)	F	F
134	M	T	None	I	(0-2)	F	F
135	F	F	None	I	(0-2)	F	F
136	M	F	None	I	(0-2)	F	F
137	F	T	None	I	(4-8)	F	F
138	F	T	None	I	(2-4)	F	F
139	F	T	None	I	(4-8)	F	T
140	M	F	None	I	(0-2)	F	F

Age	Options = 19 - 74
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APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
Respondent Number							
141	M	F	None	C	(0-2)	F	F
142	F	T	None	I	(0-2)	F	T
143	M	T	None	I	(0-2)	F	T
144	M	T	None	I	(2-4)	F	F
145	M	F	None	I	(0-2)	F	T
146	F	F	None	I	(2-4)	F	F
147	F	F	None	I	(2-4)	F	F
148	F	T	None	I	(4-8)	F	T
149	F	T	Minimal	I	(4-8)	T	T
150	F	T	Minimal	I	(4-8)	F	T
151	F	T	Minimal	I	(0-2)	F	F
152	M	F	None	I	(2-4)	F	T
153	M	F	None	I	(2-4)	F	F
154	M	F	None	I	(2-4)	F	T
155	M	F	None	I	(2-4)	F	F
156	M	F	None	I	(0-2)	F	T
157	M	F	None	I	(0-2)	F	T
158	M	T	None	I	(2-4)	F	T
159	M	T	Reduced Wk. Eff.	I	(2-4)	F	T
160	M	T	None	I	(2-4)	F	T
161	M	T	None	I	(2-4)	F	F
162	M	T	None	I	(2-4)	F	F
163	M	T	Minimal	I	(2-4)	F	T
164	M	T	None	I	(2-4)	F	T
165	M	T	Minimal	I	(4-8)	F	F
166	M	T	Minimal	I	(0-2)	F	T
167	M	T	None	I	(2-4)	F	T
168	M	T	None	I	(4-8)	F	T
169	M	T	None	I	(4-8)	F	T
170	M	T	None	I	(2-4)	F	F
171	F	F	None	I	(2-4)	F	F
172	F	F	None	I	(0-2)	F	F
173	M	F	None	I	(0-2)	F	T
174	M	T	None	I	(2-4)	F	T
175	M	T	None	I	(4-8)	F	F
176	M	T	None	I	(0-2)	F	T

Age
Options = 19 - 74
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APPENDIX C: ERGONOMICS SURVEY DATA AND STATISTICS							
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
Respondent Number							
177	M	T	None	I	(2-4)	F	I
Total of All	177	177	177	177	177	177	177
Total Var. A	82	106	140	26	64	16	72
Total Var. B	95	71	35	151	47	161	105
Total Var. C	N/A	N/A	2	N/A	66	N/A	N/A
Total Var. D	N/A	N/A	0	N/A	N/A	N/A	N/A
% Var. A	46%	60%	79%	15%	36%	9%	41%
% Var. B	54%	40%	20%	85%	27%	91%	59%
% Var. C	N/A	N/A	1%	N/A	37%	N/A	N/A
% Var. D	N/A	N/A	0%	N/A	N/A	N/A	N/A
Total %	100%	100%	100%	100%	100%	100%	100%
Legend of Variables In Each Column	Var. A = M Var. B = F	Var. A = T Var. B = F	Var. A = None Var. B = Minimal Var. C = RWE Var. D = Lost Tm.	Var. A = C Var. B = I	Var. A = (0-2) Var. B = (2-4) Var. C = (4-8)	Var. A = T Var. B = F	Var. A = T Var. B = F

Age	
Options = 19 - 74	
	38
Total:	177
Max:	74
Min:	19
Avg.:	43
St. Dev.:	11.8112156
Variance:	139.504815

APPENDIX D

APPENDIX D: RESPONDENTS WITH SIGNS & SYMPTOMS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
		Options = M/F	Options = T/F	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
1	F	T	Minimal	I	(0-2)	F	T
10	F	T	Minimal	I	(2-4)	F	F
11	F	T	None	I	(0-2)	F	T
12	F	T	None	I	(4-8)	F	F
13	F	T	None	I	(0-2)	F	F
14	F	T	None	I	(2-4)	F	F
15	F	T	Minimal	I	(4-8)	F	T
16	F	T	None	I	(0-2)	F	T
17	F	T	None	I	(0-2)	F	F
27	M	T	None	I	(0-2)	F	F
28	M	T	Reduced Wk. Eff.	C	(0-2)	T	F
30	F	T	None	I	(4-8)	F	T
32	M	T	Minimal	C	(4-8)	F	T
44	F	T	None	I	(2-4)	F	F
45	F	T	Minimal	C	(4-8)	F	F
46	F	T	None	C	(4-8)	F	F
47	F	T	Minimal	I	(0-2)	F	T
48	F	T	None	I	(2-4)	F	F
49	F	T	None	I	(0-2)	F	F
50	F	T	Minimal	C	(4-8)	F	F
51	F	T	Minimal	C	(4-8)	T	T
52	F	T	Minimal	I	(2-4)	T	T
53	F	T	Minimal	I	(0-2)	F	F
54	F	T	Minimal	I	(2-4)	T	T
55	F	T	Minimal	I	(4-8)	F	F
56	F	T	None	I	(4-8)	F	T
57	F	T	Minimal	C	(4-8)	F	F
58	F	T	Minimal	I	(4-8)	F	F
59	F	T	Minimal	I	(4-8)	T	F
60	F	T	None	I	(4-8)	T	F
61	F	T	Minimal	I	(4-8)	F	T
62	F	T	None	I	(0-2)	F	F
63	F	T	None	I	(2-4)	F	F
64	F	T	Minimal	I	(4-8)	T	F

	Age
	Options = 19 - 74
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APPENDIX D: RESPONDENTS WITH SIGNS & SYMPTOMS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
65	F	T	None	I	(0-2)	F	F
66	F	T	None	C	(4-8)	F	F
67	F	T	Minimal	I	(4-8)	F	T
68	F	T	Minimal	I	(4-8)	F	F
69	F	T	Minimal	C	(4-8)	T	T
70	F	T	None	I	(4-8)	T	F
75	M	T	Minimal	I	(2-4)	T	F
76	M	T	None	I	(4-8)	F	T
77	M	T	None	I	(0-2)	F	T
78	M	T	None	I	(0-2)	F	F
79	M	T	None	I	(4-8)	F	T
80	M	T	None	I	(4-8)	F	T
81	M	T	None	I	(4-8)	F	F
83	F	T	None	I	(4-8)	F	F
85	M	T	None	I	(2-4)	F	F
86	F	T	None	I	(0-2)	F	T
87	M	T	None	C	(4-8)	F	T
89	F	T	Minimal	I	(4-8)	F	T
90	F	T	None	C	(4-8)	F	F
91	F	T	None	I	(4-8)	F	F
100	M	T	None	I	(0-2)	F	T
101	M	T	None	I	(0-2)	F	T
102	M	T	None	C	(4-8)	F	T
103	M	T	None	C	(4-8)	F	F
104	M	T	None	C	(4-8)	F	T
105	M	T	Minimal	C	(4-8)	F	F
109	F	T	Minimal	I	(2-4)	T	F
111	M	T	Minimal	I	(2-4)	F	T
112	M	T	None	I	(2-4)	T	F
113	M	T	None	I	(4-8)	F	F
117	F	T	None	I	(0-2)	F	F
118	F	T	Minimal	I	(0-2)	T	T
119	F	T	None	I	(4-8)	F	F
122	M	T	None	I	(0-2)	F	T
124	F	T	None	I	(0-2)	F	F
125	F	T	Minimal	I	(2-4)	F	T

Age	Options = 19 - 74
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APPENDIX D: RESPONDENTS WITH SIGNS & SYMPTOMS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
			Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F
126	F	T	None	I	(2-4)	F	F
127	F	T	None	I	(4-8)	F	T
128	F	T	None	I	(2-4)	F	F
129	F	T	Minimal	I	(4-8)	F	F
130	F	T	None	I	(4-8)	F	T
131	F	T	None	I	(4-8)	F	T
132	F	T	None	I	(2-4)	F	F
133	F	T	Minimal	I	(4-8)	F	F
134	M	T	None	I	(0-2)	F	F
137	F	T	None	I	(4-8)	F	F
138	F	T	None	I	(2-4)	F	F
139	F	T	None	I	(4-8)	F	T
142	F	T	None	I	(0-2)	F	T
143	M	T	None	I	(0-2)	F	T
144	M	T	None	I	(2-4)	F	F
148	F	T	None	I	(4-8)	F	T
149	F	T	Minimal	I	(4-8)	T	T
150	F	T	Minimal	I	(4-8)	F	T
151	F	T	Minimal	I	(0-2)	F	F
158	M	T	None	I	(2-4)	F	T
159	M	T	Reduced Wk. Eff.	I	(2-4)	F	T
160	M	T	None	I	(2-4)	F	T
161	M	T	None	I	(2-4)	F	F
162	M	T	None	I	(2-4)	F	F
163	M	T	Minimal	I	(2-4)	F	T
164	M	T	None	I	(2-4)	F	T
165	M	T	Minimal	I	(4-8)	F	F
166	M	T	Minimal	I	(0-2)	F	T
167	M	T	None	I	(2-4)	F	T
168	M	T	None	I	(4-8)	F	T
169	M	T	None	I	(4-8)	F	T
170	M	T	None	I	(2-4)	F	F
174	M	T	None	I	(2-4)	F	T
175	M	T	None	I	(4-8)	F	F
176	M	T	None	I	(0-2)	F	T

Age
Options = 19 - 74
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APPENDIX D: RESPONDENTS WITH SIGNS & SYMPTOMS									
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?	Age	
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F	Options = 19 - 74	
Respondent Number									
177	M	T	None	I	(2-4)	F	T	38	
Total of All	106	106	106	106	106	106	106	106	Total:
Total Var. A	42	106	69	15	27	14	50	74	Max:
Total Var. B	64	0	35	91	29	92	56	20	Min:
Total Var. C	N/A	N/A	2	N/A	50	N/A	N/A	43	Avg.:
Total Var. D	N/A	N/A	0	N/A	N/A	N/A	N/A	11,731,4094	St. Dev.:
% Var. A	40%	100%	65%	14%	25%	13%	47%	137,625,966	Variance:
% Var. B	60%	0%	33%	86%	27%	87%	53%		
% Var. C	N/A	N/A	2%	N/A	47%	N/A	N/A		
% Var. D	N/A	N/A	0%	N/A	N/A	N/A	N/A		
Total %	100%	100%	100%	100%	100%	100%	100%		
Legend of Variables	Var. A = M	Var. A = T	Var. A = None	Var. A = C	Var. A = (0-2)	Var. A = T	Var. A = T		
In Each Column	Var. B = F	Var. B = F	B = Minimal	Var. B = I	Var. B = (2-4)	Var. B = F	Var. B = F		
			= RWE		Var. C = (4-8)				
			Lost Tm.						

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APPENDIX E

APPENDIX E: RESPONDENTS WITH NO SIGNS & SYMPTOMS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?
		Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F
2	M	F	None	C	(0-2)	F	F
3	F	F	None	I	(2-4)	F	F
4	F	F	None	I	(4-8)	F	F
5	F	F	None	I	(0-2)	F	F
6	F	F	None	I	(4-8)	F	F
7	F	F	None	I	(0-2)	F	T
8	F	F	None	I	(4-8)	F	F
9	F	F	None	I	(0-2)	F	T
18	M	F	None	I	(0-2)	F	T
19	M	F	None	I	(0-2)	F	F
20	M	F	None	I	(0-2)	F	F
21	M	F	None	C	(0-2)	F	T
22	M	F	None	I	(0-2)	F	F
23	M	F	None	I	(0-2)	F	F
24	M	F	None	C	(0-2)	F	F
25	M	F	None	I	(0-2)	F	T
26	M	F	None	I	(0-2)	F	F
29	F	F	None	I	(2-4)	F	F
31	M	F	None	I	(2-4)	F	F
33	F	F	None	I	(4-8)	F	F
34	F	F	None	I	(4-8)	F	F
35	F	F	None	I	(0-2)	F	T
36	F	F	None	I	(0-2)	F	F
37	F	F	None	I	(4-8)	F	F
38	F	F	None	I	(2-4)	F	F
39	F	F	None	I	(2-4)	F	F
40	F	F	None	I	(4-8)	F	F
41	F	F	None	I	(4-8)	T	F
42	F	F	None	I	(0-2)	F	F
43	F	F	None	I	(2-4)	F	F
71	M	F	None	I	(0-2)	F	T
72	M	F	None	I	(4-8)	F	F
73	M	F	None	I	(0-2)	F	F

Age
Options = 19 - 74
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APPENDIX E: RESPONDENTS WITH NO SIGNS & SYMPTOMS							
Respondent Number	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours Options = (0-2), (2-4), (4-8)	Receiving Treatment?	Do you participate in outside activities?
	Options = M/F	Options = T/F		Options = T/F		Options = T/F	Options = T/F
74	M	F	None	C	(0-2)	F	F
82	F	F	None	I	(0-2)	F	F
84	M	F	None	I	(2-4)	F	F
88	F	F	None	I	(4-8)	F	T
92	M	F	None	I	(0-2)	F	T
93	M	F	None	I	(0-2)	F	F
94	M	F	None	C	(4-8)	F	F
95	M	F	None	C	(4-8)	F	F
96	M	F	None	C	(4-8)	F	T
97	M	F	None	C	(4-8)	F	F
98	M	F	None	C	(4-8)	F	F
99	M	F	None	C	(4-8)	T	T
106	F	F	None	I	(2-4)	F	F
107	M	F	None	I	(0-2)	F	T
108	M	F	None	I	(2-4)	F	T
110	M	F	None	I	(2-4)	F	F
114	F	F	None	I	(2-4)	F	F
115	F	F	None	I	(0-2)	F	F
116	F	F	None	I	(0-2)	F	T
120	M	F	None	I	(0-2)	F	T
121	M	F	None	I	(0-2)	F	T
123	F	F	None	I	(0-2)	F	F
135	F	F	None	I	(0-2)	F	F
136	M	F	None	I	(0-2)	F	F
140	M	F	None	I	(0-2)	F	F
141	M	F	None	C	(0-2)	F	F
145	M	F	None	I	(0-2)	F	T
146	F	F	None	I	(2-4)	F	F
147	F	F	None	I	(2-4)	F	F
152	M	F	None	I	(2-4)	F	T
153	M	F	None	I	(2-4)	F	T
154	M	F	None	I	(2-4)	F	F
155	M	F	None	I	(2-4)	F	F
156	M	F	None	I	(0-2)	F	T
157	M	F	None	I	(0-2)	F	T
171	F	F	None	I	(2-4)	F	F

Age	Options = 19 - 74
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APPENDIX E: RESPONDENTS WITH NO SIGNS & SYMPTOMS									
	Sex	Signs & Symptoms	How Signs & Symptoms Affect Work	Is Work at Computer Continuous or Intermittent?	Daily Time Spent at Computer in hours	Receiving Treatment?	Do you participate in outside activities?	Age	
	Options = M/F	Options = T/F	Options = None, Minimal, Reduced Wk. Eff., & Lost Time	Options = T/F	Options = (0-2), (2-4), (4-8)	Options = T/F	Options = T/F	Options = 19 - 74	
Respondent Number									
172	F	F	None	I	(0-2)	F	F	38	
173	M	F	None	I	(0-2)	F	T	56	
Total of All	71	71	71	71	71	71	71	71	Total:
Total Var. A	40	0	71	11	37	2	22	68	Max:
Total Var. B	31	71	0	60	18	69	49	19	Min:
Total Var. C	N/A	N/A	0	N/A	16	N/A	N/A	43	Avg.:
Total Var. D	N/A	N/A	0	N/A	N/A	N/A	N/A	12.0107095	St. Dev.:
% Var. A	56%	0%	100%	15%	52%	3%	31%	144.257143	Variance:
% Var. B	44%	100%	0%	85%	25%	97%	69%		
% Var. C	N/A	N/A	0%	N/A	23%	N/A	N/A		
% Var. D	N/A	N/A	0%	N/A	N/A	N/A	N/A		
Total %	100%	100%	100%	100%	100%	100%	100%		
Legend of Variables In Each Column	Var. A = M Var. B = F	Var. A = T Var. B = F	Var. A = None B = Minimal C = RWE D = Lost Tm.	Var. A = C Var. B = I	Var. A = (0-2) Var. B = (2-4) Var. C = (4-8)	Var. A = T Var. B = F	Var. A = T Var. B = F		

VITA

Jamie K. Arnold was born in Anne Arundel County, Maryland to David and Lynda Keplinger. She is the granddaughter of Mrs. Mildred Keplinger and the late Mr. Arthur Keplinger, and the granddaughter of Mr. C.T. Slagle, and the late Mrs. Emma Slagle Andes. She attended Lamar Elementary School in Jonesborough, Tennessee. She attended David Crockett High School and accelerated to college in August of 1985 at East Tennessee State University, after completion of her high school junior year. She was a college sophomore when she graduated from David Crockett High School in June 1986. She received a Bachelor of Business Administration degree in Finance from East Tennessee State University in May of 1989. She entered the University of Tennessee in August, 1994 and in December, 1995 received a Master of Science degree in Safety Education and Service.

She is presently employed as the Corporate Safety and Health Officer at PAI Corporation in Oak Ridge, Tennessee.