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ABSTRACT

The proliferation of office automation in the workplace environment has been accompanied by a wave of growing concern over the potential negative side effects on the quality of worklife of user employees. Issues which have surfaced include: visual, postural and other health hazards; increased work stress; and adverse impact on the overall quality of life. The purpose of this paper is to describe some of these problems and report on both the findings and recommendations of various studies that have been conducted on these issues. This paper is also intended to emphasize the vital role that authorities involved in the management of information systems must play to seriously address these concerns. We must insure the best use of office automation technology while, at the same time, providing for a better quality environment. The fruits of our success will lead to improved employee moral and performance, increased productivity and, ultimately, to an enhanced quality of worklife.

INTRODUCTION

The modern office is rooted in the 1930's - 1940's and can be traced to the invention of the photocopier and the computer just prior to World War II. The progress to xerography in the 1960's released the paperwork landslide. Close on the heels of this innovation was the utilization of the computer as an office medium for storage and retrieval of information. The computer's grip on office procedures was quick and breathtaking. Various surveys indicate that seven out of ten white collar workers now

interact with a computer in some fashion.[1] However, the office
environment has remained relatively stable and slow to change.
Even physical office design has changed little since the 1950's.
In addition, the workforce has become characterized by individuals
who perform their assignments in highly personalized ways and who
desire to achieve a quality worklife that is meaningful, varied
and informal.

The seeds for controversy were sown in the conflicting
environmental needs and traditions and the capabilities of office
automation, requiring marked efforts toward their integration.
The first real step in the adaptation of people to computers
occurred when the typewriter keyboard was paired with the CRT.[2]
Mechanical restrictions were lifted and the speed of interaction
was markedly increased. In addition, the user formulation of
inputs was significantly simplified and quickened due to electronic
editing. But while the CRT was a step in the right direction, it
did not arrive without some kinks. Legibility, readability, and
comfort were issues which impacted the human work force. Human
engineering in the 1970's introduced new generations of VDT's
with more focus on human comfort as well as more enhanced capabi-
lities. Character resolution, two levels of character brightness,
light characters on dark backgrounds and vice versa, and detachable
keyboards added to workplace comfort. The VDT of the 1980's has
been additionally impacted by human engineering, as problems and
concerns with its use increased. Rotatable and tiltable display
screens and glare reducing filters are just two of the benifits

which have resulted. The VDT technology will continue to receive much attention. In addition to improved resolution, the advent of colors, split-screen capabilities, three dimensional perspectives and other advancements are near realization. Flat electronic displays will not only reduce terminal size, but will also be accompanied by superior resolution. This feature will allow incorporation of the display into the work station instead of on the desk surface. Voice communication with the computer is on the, horizon as a practical application. Authorities warn that it, like the VDT, will be accompanied by some adverse effects on the environment (acoustical problems, noise distractions, etc.) that must be addressed.

The rise in office automation applications was accompanied by work reorganization which in turn affected office design. Most notably, there is increased recognition for the need of flexibility in office layout to accomodate the new equipment. The new equipment places emphasis on a building's electrical, heating, ventilation, airconditioning, acoustic, lighting, and security systems. New equipment accentuates heat, noise, and glare problems. These challenges are being addressed by developers and managers who are making progress in "building technology". Such problems are being handled by new products like fiber optics, flat cables, raised flooring, zoned heating/ventilation systems and increasing sophistication in design principles. These advances are being fitted to existing structures, preventing building obsolescence, and being incorporated into new facilities giving momentum to the

movement toward "smart buildings."[3] However, the development of design specifications for the automated office must also incorporate a comprehensive awareness of the people involved in the office process, both as contributing members of the organization and as individuals with personal and social needs.[4]

ERGONOMICS AND HUMAN ENGINEERING

The terms ergonomics and human factors are often used interchangably. Rubin states that "the discipline of ergonomics focuses on the interaction of the person with his/her surroundings: environmental, workspace, informational, social and technological. Scout (1981) emphasizes that productivity gains do not depend solely on technological factors, but on a spectrum of activities including people, management, and technology---and that the ergonomics area provides the greatest potential for improvement because of its neglect."[5] As concerns about productivity, employee job satisfaction, health and safety in the work force have increased, interest in human factors has also risen. User interface design for the automated office has received increasing attention and its relationship to the field of ergonomics has become closely symbiotic.

While it is essential to understand that the field of ergonomics and human factors have broad implications for all aspects of work, this paper will focus on their application to the particular physical and mental aspects of work which relate to office automation. Physical features such as furniture design, office layout, noise

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and lighting have been impacted by ergonomics. In addition there are now distinct guidelines and recommendations for size, color, and positioning of VDT screens as well as measurement specifications for furniture and keyboard layout.

OFFICE AUTOMATION CONCERNS

A sampling of topics will indicate the strength of the role that ergonomics plays in impacting both the problems and potential of office automation. A review of automation concerns including workstation design, lighting, acoustics, and physiological problems of VDT use gives a broad overview of how office automation and ergonomics have become mutually inclusive. In addition, numerous studies are cited to reflect the various approaches and/or attempts which have been undertaken to address these concerns and challenges.

Eye Problems

Galitz refers to various studies about eye problems associated with the use of VDT's. The most frequently reported visual discomforts were: eye strain, burning and/or irritated eyes, and blurred or double vision. A moderate correlation was found between visual problems and time spent on the VDT. Galtiz lists potential causes of visual discomfort with using VDT's: equipment/environment factors such as screen reflections and flickering; equipment factors like display of characters with excessive brightness; low stability; poor sharpness; poor legibility; and low contrast between display characters and background. In addition,

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human factor elements may also play a role. For example, uncorrected eye defects naturally pose a problem---and the use of eyeglasses originally designed for everyday reading purposes may be harmful because normal reading distance varies from VDT distance.[6] Fortunately, manufacturers have realized the impact of user requirements and have incorporated them into modern VDT design. The trend is toward developing electronic displays that are specifically designed for intense, long term office tasks.

Postural Problems

Like visual discomfort, many studies have unearthed reports of postural problems associated with VDT use. The most frequently mentioned problems are pains in the neck, shoulder, back, arms and hands. Factors which can contribute to postural discomfort include improper viewing angles, poor chair design, and high rates of input. Ergonomic enhancements in computer support furniture serve to alleviate some of these problems. Some vendors offer computer workstations that include separate adjustable surfaces for a VDT or monitor. These multi or split-level surfaces provide users with flexibility to adjust the VDT to his/her optimum viewing distance, thereby alleviating some vision and postural discomfort. Others offer add-on retractable keyboard platforms which position the keyboard at a standard and comfortable typing height of 28 inches.

The use of the applied science of ergonomics has also reinforced proper chair and workstation design. Since humans

were designed for walking, not sitting, the intense use of VDT's and workstations in a sitting position can place great physical stress on the human body. This leads to inherent instability, and the process of searching for restabilization is the core of ergonomic seating.[7] Some of the recommendations to provide skeletal support, negate muscle fatigue, curb blood flow problems, and reduce pressure on the lumbar disks according to Dainoff include:[8]

1. Variety of chairs for various sizes and statues of people.

2. Contour-padded seat and back.

3. Seat height adjustment while seated.

4. Lumbar support via back height adjustment and full tilt.

5. Back tilt and seat tilt adjustment while seated.

6. Various static-posture settings or free flowing dynamic motion.

7. Mechanical reliability and safety conforming with ANSI-BIFMA standards.

Lighting Problems

For the past forty years, office illumination has been tailored to "white paper" tasks, which utilize non-reflective white paper and viewing on a horizontal plane. But a VDT presents a near vertical task surface that is highly reflective and affords less contrast (than print and paper) between details and background. Traditional lighting on a VDT can create an impediment which slows tasks by blurring details and increases operator errors. These concerns have given momentum to the field of lighting management. By applying lighting management and concentrating on

the quality of results, overall productivity and performance will increase. Ergonomically conducive lighting can alleviate eyestrains and headaches, and increase productivity. The designer of the visual environment according to Leuder should be concerned with:[9]

1. providing enough light to do the job quickly and accurately, and providing enough flexibility to cater for the different age groups of users.

2. providing the right kind of light suitable for color display.

3. Limiting glare and extreme contrasts in brightness which cause dicomfort and reduce the ability to see clearly.

4. Keeping the costs down and conserving energy.

Noise Problems

While there is no persuasive evidence that general noise levels adversely affect reaction time, or have an impact on learning or intelligence/coordination tasks, there are indications that certain distractions/noises may affect the performance of complex tasks calling for vigilance, skill and speed, and a high level of perceptual capacity and complex psychomotor tasks.[10] Other studies, reveal that perceptions of noise levels depend on individual attitudes as well as decibel levels. In addition, noise may reduce an individual's sociability and sensitivity to the needs of others.[11]

Sound levels above 60 decibels in offices are usually considered "noisy". A 1978 Kaplan study revealed that high office noise can cause psychological effects, including the inability to think and

work effeciently. With the advent of voice computers, noise levels may reach a crisis stage. It is therefore imperative to begin an immediate resolution of this concern in the office environment. An effective noise control program will feature the use of sound absorbent materials, sound masking systems, and an office layout which create appropriate barriers to noise pollution. Some of the recommendations from Leuder include:[12]

1. Specify clearly current and future office usage and general requirements.

2. Convert requirements into technical specifications.

3. Develop layouts to separate quiet places from machinery or circulation/coffee areas.

4. Ensure selection of quietest office equipment and adequate noise control for any remaining noisy machinery.

5. Define and specify the acoustic requirements of inter-office partitions including cladding, ceiling, computer flooring, doors, services, floor coverings, etc.

WORKSTATION DESIGN

The integration of physical components of the environment that allow a worker to perform his/her job most comfortably, efficiently, and accurately, often begin with workstation design. A workstation may be a simple disk or a complex executive work area and storage facility. Productivity lags can be intricately linked to poor workstation design. Awkward operating positions, inefficient workspace organization, and lack of workspace can all adversely

affect productivity. Good workstation design depends upon proper construction and arrangement of the job "parts" so they all fit and work well together.[13]

Applied ergonomics have developed workstation guidelines to enhance worker comfort and productivity. A concern hampering the design of an ergonomically sound workstation is the lack of communication and cooperation among all parties involved. Furniture manufacturers, terminal manufacturers, facilities managers, and computer users should begin a coordinated team effort now. The U.S. Department of Labor has issued guidelines for features to be included in workstation design.[14]

CONCLUSION

Seven out of ten office designers report that employees complain of eyestrain, followed by backaches and headaches.[15] Though more and more information is available to management on ergonomically efficient office design, there remains a dramatic void between what "is" and what "should be". Study after study continues to highlight the need for a fully integrated office environment to capture the potential of today and to insure the promise of tomorrow. We must begin to carefully plan for the emerging electronic office.

The future is here! Tomorrow's office is just around the corner. We have few technological concerns, but human factors and ergonomic considerations will achieve ever increasing importance in future environmental design. Tomorrow's office must provide

the proper social environment in addition to serving as the workplace. Privacy will be a key consideration. There must be attention focused on job design to prevent work from becoming too comfortable---walking the fine line between healthy diversity and fatigue.

A concrete benefit of increased attention on the environment will be increased productivity. Other benefits include lowered absenteeism, reduced turnover and decreased worker's compensation claims---all of which transfer to the firm's profitability. We must become aware that a successful business will orchestrate a harmony of worker, technology and environment. Office architects must design conditions where jobs, automated systems, equipment, environment and the human needs of the worker blend into an integrated whole. For it is only after we create this integrated whole that the _management_ of change can truly begin.

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