

ERGONOMIC DESIGN OF COMPUTER WORKSTATION

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Abstract -Ergonomics (or human factors) is a discipline of science in which we study about human behavior with respect to its surroundings. The purpose of this paper is to study the effects of surroundings and workstation on human samples and ways by which we can increase human working efficiencies in computer workstation. The effects of various peripheral devices used in a computer workstation are also looked upon. The state of computer operator is measured in the amount of stress he is in while working in workstation, which can be calculated by the heart rate and blood pressure of the operator at various time intervals which shows his state of mind as well as body comfort while working. Based on literature review the most effective factors include the sitting posture of the worker as well as the repetitive tasks which he has to do. Other risk factors include uncomfortable workplace design and un-ergonomically designed of workstation. This study will help to increase awareness and need for ergonomically designed computer workstation.

Key Words: Computer workstation, peripherals, ergonomics, risk factors, human efficiency, human sampling.

1.INTRODUCTION

Ergonomics normally are known to be related to human and their job. In larger scope ergonomics examines human behavioral, psychological, and physiological capabilities and limitations. Professionals in the field of ergonomics normally will design new work environments or modify established work environments based on the studies on the human capabilities and limitation. The basic premise of ergonomics is that job demands should not exceed workers' capabilities and limitations to ensure that they would not be exposed to work stresses that can adversely affect safety and health as well as the company's productivity. Therefore, the objective of an ergonomics program is to provide a safe and productive workplace to the worker's comfort to fulfill the goals and objectives of the organization.

1.1 Definition of ergonomics

Reviews of numerous researches of ergonomics are using a variety of definitions to describe the concept. Below are the definitions of ergonomics stated by previous authors.

Te-Hsin & Kleiner [1] -Ergonomics is a combination of the words ergo, a Greek word meaning "work" and nomics, meaning "study" - the study of work.

Tayyari & Smith [2]- A branch of science that is concerned with the achievement of optimal relationships between workers and their work environment.

Lee [3]- Promoting compatibility between humans and systems.

Fernandez [4] The design of the workplace, equipment, machine, tool, product, environment and system, taking into consideration the human's physical, physiological, biomechanical and psychological capabilities and optimizing the effectiveness and productivity of work systems while assuring the safety, health and wellbeing of the workers. In general, the aim in ergonomics is to fit the task to the individual, not the individual to the task.

1.2 Domain of ergonomics

Ergonomics comprise three main fields of research: Physical, cognitive and organizational ergonomics. There are many specializations within these broad categories. Specializations in the field of physical ergonomics may include visual ergonomics. Specializations within the field of cognitive ergonomics may include usability, human-computer interaction, and user experience engineering.

Some specializations may cut across these domains: *Environmental ergonomics* is concerned with human interaction with the environment as characterized by climate, temperature, pressure, vibration and light.^[9] The emerging field of human factors in highway safety uses human factor principles to understand the actions and capabilities of road users - car and truck drivers, pedestrians, bicyclists, etc. - and use this knowledge to design roads and streets to reduce traffic collisions. Driver error is listed as a contributing factor in 44% of fatal collisions in the United States, so a topic of particular interest is how road users gather and process information about the road and its environment, and how to assist them to make the appropriate decision.^[10]

New terms are being generated all the time. For instance, "user trial engineer" may refer to a human factors professional who specializes in user trials.^[citation]

needed] Although the names change, human factors professionals apply an understanding of human factors to the design of equipment, systems and working methods in order to improve comfort, health, safety, and productivity.

2. Ergonomics in Computer workstation

Ergonomics is widely used of computer workstation so as to improve the performance of computer operator. Following considerations should be given importance while designing computer workstation:

- Accessories required to operate properly
- Layout of equipment on the desk
- Location of furniture in the room
- Accessibility to various peripheral devices

2.1 Devices used in Computer workstation

1. Keyboards-

Place the keyboard in a position that allows the forearms to be close to the horizontal and the wrist to be straight. That is, with the hands in line with the forearm. If this causes the elbows to be far out from the side of the body then re-check the work surface height.

Some people prefer to have their wrist supported on a wrist rest or the desk. Be careful not to have the wrist extended or bent in an up position.

2. Chairs-

Adjust the seat tilt so that you are comfortable when you are working on the keyboard. Usually this will be close but some people prefer the seat tilted slightly forward.

Your knees should be bent at a comfortable angle and greater than 90° flexion. If this places an uncomfortable strain on the leg muscles, or if the feet do not reach the floor, then a footrest should be used. The footrest height must allow your knees to be bent at 90°, the height of the footrest may need to be adjustable.

3. Phones-

Avoid cradling the phone between your head and shoulder when answering calls. If you need to use your computer at the same time, use a headset or the phone's hands-free/speaker-phone capabilities if the environment is suitable.

4. Monitor -

Set the eye-to-screen distance at the distance that permits you to most easily focus on the screen. Usually this will be within an arm's length.

Set the height of the monitor so that the top of the screen is below eye level and the bottom of the screen can be read without a marked inclination of the head. Usually this means that the centre of the screen will need to be near shoulder height. Your eyes should be level with the tool bar.

People who wear bifocal or multi-focal lenses will need to get a balance between where they see out of their lenses and avoid too much neck flexing. The height of the monitor can be adjusted using a monitor riser.

5. Desk-

Adjust the height of the work surface and/or the height of the chair so that the work surface allows your elbows to be bent at 90°, forearms parallel with the floor, wrist straight, shoulders relaxed.

Place all controls and task materials within a comfortable reach of both hands so that there is no unnecessary twisting of any part of the body. Most people prefer the document holder to be between the keyboard and the monitor. There are many different types of document holders available.

6. MOUSE-

A well-designed mouse should not cause undue pressure on the wrist and forearm muscles. A large bulky mouse may keep the wrist continuously bent at an uncomfortable angle.

Pressure can be reduced by releasing the mouse at frequent intervals and by selecting a slim-line, low-profile mouse. Keep the mouse as close as possible to the keyboard, elbow bent and close to the body.

7. Posture-

Good posture is essential for all computer users. You should adopt a natural and relaxed position, providing opportunity for movement, from which you can assume a number of alternative positions.

8. Keyboard equipment and radiation-

Good posture is essential for all computer users. You should adopt a natural and relaxed position, providing opportunity for movement, from which you can assume a number of alternative positions.

9. Posture and Environment-

Change your posture at frequent intervals to minimize fatigue. Avoid awkward postures at the extremes of the joint range, especially the wrists.

Take frequent short rest breaks rather than infrequent longer ones. Avoid sharp increases in work rate. Changes should be gradual enough to ensure that the workload does not result in excessive fatigue.

After prolonged absences from work the overall duration of periods of keyboard work should be increased gradually if conditions permit.



Fig -1: Devices used in Computer workstation.

4.Literature review-

[1] A Literature Review of Ergonomics Risk Factors in Construction Industry

N. Jaffar*, A. H. Abdul-Tharim, I. F. Mohd-Kamar, N. S. Lop
University Teknologi MARA Perak, Seri Iskandar,32610 Perak, Malaysia.The purpose of this paper is to overview the ergonomics risk factors in construction industry. The objective is to give a basic introduction and clear definition of ergonomic. The study will include the ergonomics risk factors in relation of human and their nature of work. Based on the literature, the most significant ergonomics risk factors are awkward posture in handling job task, force and repetition of specific movement including vibration. Other ergonomics risk factor includes uncomfortable static position, contact stress of muscles and tendon and also extreme temperature condition.

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December-799^ Human Factors Engineering/Ergonomics enhances not only to the efficiency of a man-machine system, but it also contributes to the goal of achieving an optimal level of human performance amalgamated with a protected and hazard free working environment from operators' view point. Human performance is directly dependent on the physical and mental capabilities and limitations of the concerned operator.

[3] Occupational musculoskeletal and mental health: Significance of rationalization and opportunities to create sustainable production systems - A systematic review
Volume 42, Issue 2, January 2011, Pages 261-296

R. H. Westgaard | J. Winkel. This literature review aims to identify occupational musculoskeletal and mental health effects of production system rationalization as well as organizational-level measures that may improve health outcome ("modifiers" in this review). A short review of the effect of ergonomic interventions is included as background and rationalization is discussed as a theoretical concept. Indicator variables for occupational musculoskeletal and mental health and related risk factors are presented. Variables with a generalized format were allowed in the literature searches (e.g., job satisfaction and absenteeism were accepted as risk factor and health indicator, respectively), suitable for the research fields of work sociology, organization science, human resource management (HRM) and economics research. One hundred and sixty-two studies of rationalization effects on health and risk factors and 72 organization-level modifier results were accepted into the final database.

Fundamentals of systems ergonomics/human factors
Volume 45, Issue 1, January 2014, Pages 5-13
John R. Wilson

[4] Ergonomics/human factors is, above anything else, a systems discipline and profession, applying a systems philosophy and systems approaches. Many things are labelled as system in today's world, and this paper specifies just what attributes and notions define ergonomics/human factors in systems terms. These are obviously a systems focus, but also concern for context, acknowledgement of interactions and complexity, a holistic approach, recognition of emergence and embedding of the professional effort involved within organization system. These six notions are illustrated with examples from a large body of work on rail human factors.
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Office ergonomics training and a sit-stand workstation: Effects on musculoskeletal and visual symptoms and performance of office workers
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Michelle M. Robertson | Vincent M. Ciriello | Angela M. Garabet

[5] Work Related Musculoskeletal Disorders (WMSDs) among office workers with intensive computer use is widespread and the prevalence of symptoms is growing. This randomized controlled trial investigated the effects of an office ergonomics training combined with a sit-stand workstation on musculoskeletal and visual discomfort, behaviors and performance. Participants performed a lab-based customer service job for 8 h per day, over 15 days and were assigned to: Ergonomics Trained (n = 11) or Minimally Trained (n = 11). The training consisted of: a 1.5-h interactive instruction, a sit/stand practice period, and ergonomic reminders. Ergonomics Trained participants experienced minimal musculoskeletal and visual discomfort across the 15 days, varied their postures, with significantly higher performance compared to the Minimally Trained group who had a significantly higher number of symptoms, suggesting that training plays a critical role. The ability to mitigate symptoms, change behaviors and enhance performance through training combined with a sit-stand workstation has implications for preventing discomforts in office workers. © 2012 Elsevier Ltd and The Ergonomics Society.

5. CONCLUSIONS-

After analyzing the literature reviews following conclusions could be drawn-

- Ergonomics should be used while designing any work place.
- Computer system as well as its peripheral devices must be ergonomically designed.
- The rest pauses must be adequate while operating in computer workstation.
- Use of ergonomics in workstation increases efficiency of the worker or operator.

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