RESEARCH ARTICLE

Usability Factors in Information Systems Development

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Abstract: Computers have become a commonplace technology for today's man. Computer users demand more reliable and durable interfaces from information processing applications developers. Information systems (ISs) research and development, over the years, has been steady so well that the arena has now grown into various subfields such as Cognitive Information Systems (CISs), Web Information Systems(WISs), Geographical Information Systems(GISs), Enterprise Information Systems (EISs), and so forth. Of late, ergonomics specialization too has begun to percolate into the field making it more cross-fertilizing with concerns for successful deployment, a win-win model of development and look-and-feel factor in terms of durable usage and usability. The paper presents a novel taxonomy of computer ergonomics.

Keywords: Human-Computer Interface, Information Systems

1. Introduction

Ergonomics means "Any use make the best use of efficiency of Human Design" , "The study of the conditions in which people work most effectively with machines", "The study of man in relation to his work and working surroundings", This broad science involves the application of psychologies as well as physiological principles to the design of buildings, machinery, vehicles, packaging, implements and anything else with which man comes into contact", "The source of fitting the man to the job and the job to the man, Ergonomics deals with the customs, habits, and laws of work and their relationship to employees", "The study of working conditions especially the design of equipment and furniture, in order to help people work more efficiently". [13]

Ergonomics comes from the two Greek words of "ergon," meaning work and "nomoi," meaning natural laws. Ergonomics is the scientific study of human capabilities and limitations in relation to work demands. It is also known as human engineering.

Ergonomics is the science of designing the job, equipment, and workplace to fit the worker. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.[1]

The International Ergonomics association defines ergonomics as follows. [2]

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Ergonomics is employed to fulfill the two goals of health and productivity. It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines.

According to F. Daniellou1 "Ergonomics studies the work activity in order to better contribute to the design of work means adapted to physiological and psychological characteristics of human beings with health standards and economic efficiency."

Ergonomics is a marginal subject developed in recent decades. Based on the human physical and psychology characteristics.
Ergonomics focuses mainly on the system optimization on human-machine environment, with the purpose of improving system efficiency, assuring people's safety, health and comfort.
Ergonomics refers to nearly all of systems related with people. [1]

1.1 Ergonomics goes through several stages as following:
Birth period (scientific management),
Original period (fatigue research, person selection and training),
Growing period (human-machine interface matching design),
Developing period (application area and scope is expanding).

True development started from 1980s, focusing on learning and bringing in theory and methods of ergonomics from western countries.
Ergonomics is a research method, which uses anthropometry, body mechanics, labor physiology and labour psychology to study structural characteristics and function characteristics of human body, at the same time provides the characteristic parameters of the human body such as size, weight, body surface area, proportion, centre of gravity of various parts of the body, the relationship and scope between various parts of body during activity etc. Also provides characteristic parameters of the human body such as power range, habits of action of various parts of the body. [2]

A better adaptation of work to humans will result2 in:
1. **At the operator level**:   Greater efficiency of its operating behavior, satisfaction, comfort and better health.
2. **At the company level**:   Improved productivity, reduced accidents, lower turnover.

2. Taxonomy of Ergonomics:

The International Ergonomics Association (IEA) divides ergonomics broadly into three domains:

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                              ┌──────────────┐
                              │  Ergonomics  │
                              └──────────────┘

   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
   │   Physical   │   │  Cognitive   │   │ Human Machine│   │Organizational│
   │  Ergonomics  │   │  Ergonomics  │   │  Interactor  │   │  Ergonomics  │
   └──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘

   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐
   │Working postures,│ │Mental workload,│ │Human computes│  │Work related  │
   │Medical handling,│ │decision-making,│ │  interface   │  │muscuiloskeletal│
   │for repetitive │   │skilled performance,││(HCI) or software││disorders, workplace││
   │  movements   │   │human reliability and││  Ergonomics ││layout, safety &││
   └──────────────┘   │system design │   └──────────────┘   │   health     │
                      └──────────────┘                      └──────────────┘
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Mobile HCI (MHCI) | Multinaodal Interaction (MMI) | Human Robot Interface (HRI) | Natural language interface (NLI) | Economic Quality of Interactive software
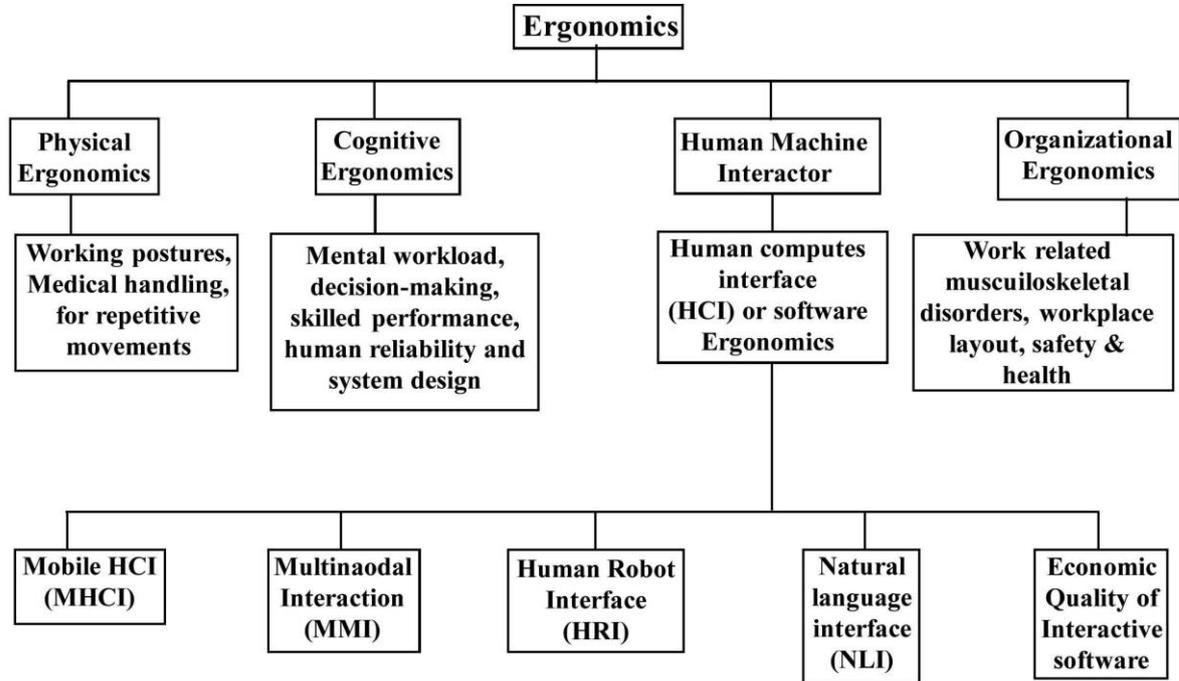
Fig 1 : Classification of Ergonomics proposed by International Ergonomics Association (IEA)

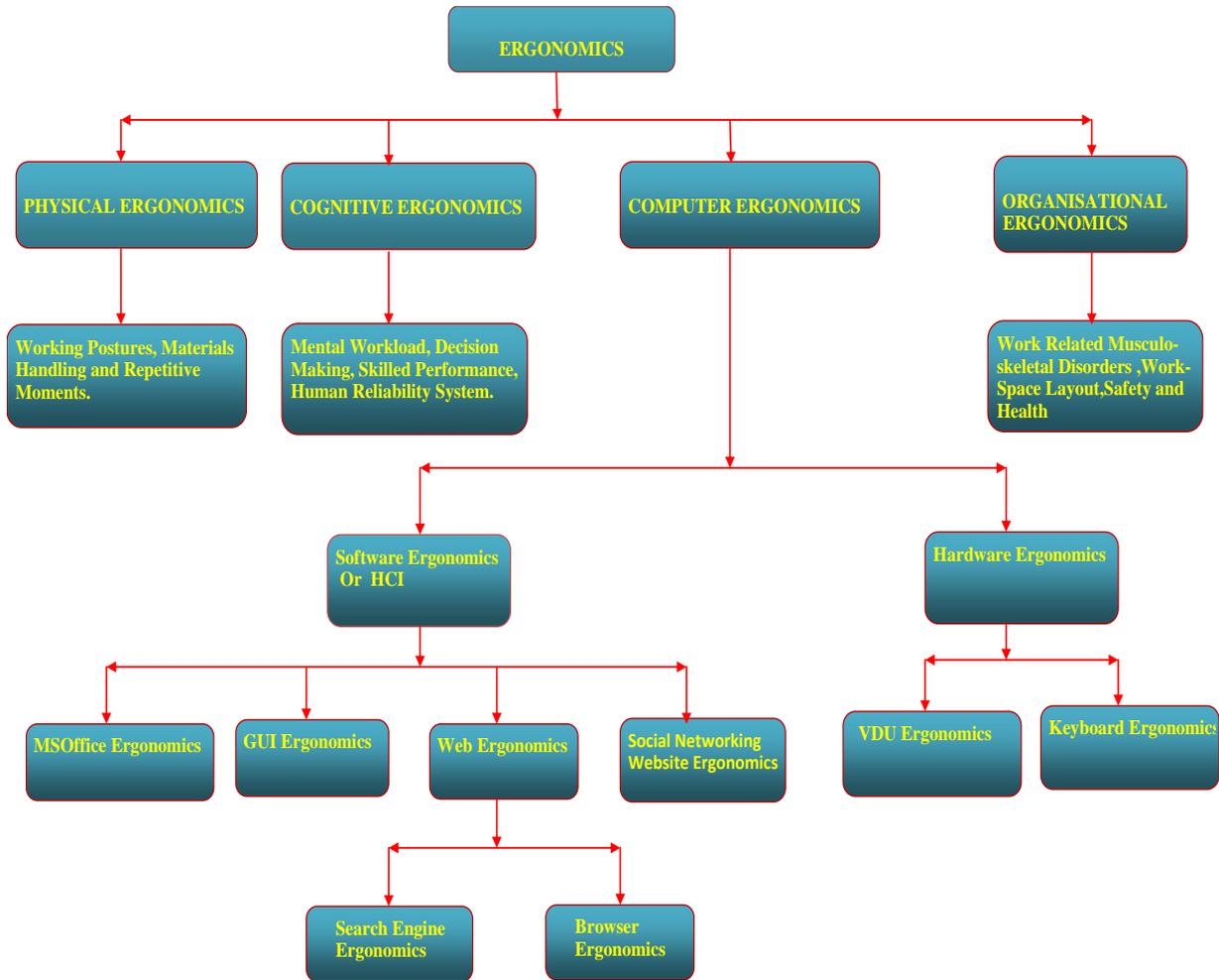## 2.1 Developed Taxonomy for Ergonomics (Authors)

Fig 2 : Classification of Ergonomics proposed by Authors(Developed)

2.1 Physical Ergonomics:

It is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. (Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health.)

Physical ergonomics is the human body's responses to physical and physiological work-loads. Repetitive strain injuries from repetition, vibration, force, and posture fall into this category.

Physical ergonomics is the type best used to describe the physical injuries resulting from over use of certain muscles, joints, and tendons, as well as strain to the eye in the workplace. Repetitive strain injuries from computer use also fall into this category of ergonomics, because of the physical strain of keyboard, mouse, and viewing the computer screen. Always make sure that the ergonomics of your workstation are compatible with your body to avoid injury.

Here are some ergonomics tips to follow while in the workplace:

· **Good posture** - Be sure to sit all the way back in your chair. Your knees should be lower than or at the same level as your hips. Keep your feet supported.

· **Typing technique** - Your arms should "float" over your keyboard - your wrists/palms should not be resting on the desktop or even on a wrist rest (unless you are breaking between typing spurts). Keep your wrists straight and hands relaxed (this is true when using your pointing device, as well). Hit the keys lightly.

· **Placement** - Your monitor should be at an arm's length away from you at eye level (you should not have to tilt your head in any way to see the screen). Keep your keyboard and mouse close together and within close reach. Center your keyboard in front of you.

Breaks - It is important to take lots of breaks. And these breaks are even better if you do some stretching during them. [4]

2.2 Cognitive Ergonomics :

Cognitive Ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system. (Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-system design.)

Cognitive ergonomics deals with the mental processes and capacities of humans when at work. Mental strain from workload, decision making, human error, and training fall into this category.

It is a branch, or domain of ergonomics that focuses mainly on the characteristics of the human mind and how that relates to activity and interactions as well as how information is obtained, used, stored and recalled when necessary. The main elements studied in Cognitive Ergonomics are sensation and perception, Memory including storage and usage and retrieve, reasoning and logical progression, Information processing, response etc..

The primary goal of Cognitive Ergonomics is to improve Cognitive tasks using different techniques such as:

- The designing of information and technology that is supportive of a variety of cognitive tasks.
- The development of specific training programs.
- Work that is designed to handle cognitive workload while at the same time improving human reliability factors. [5]

Topics that are considered as relative to the Cognitive Ergonomics are

- Decision Making.
- Human Computer Interaction.
- Human Error.
- Mental Workload.
- Skilled Performance.
- Training.
- Vigilance.

2.3 <u>Organizational ergonomics</u>: It is concerned with the optimization of socio-technical systems, including their organizational structures, policies, and processes.(Relevant topics include communication, crew resource management, work design, design of working times, teamwork, <u>participatory design</u>, community ergonomics, cooperative work, new work paradigms, virtual organizations, tele-work, and quality management.

Organizational ergonomics deals with the organizational structures, policies and processes in the work environment, such as shift work, scheduling, job satisfaction, motivation, supervision, teamwork, telecommuting, and ethics.

Organizational Ergonomics focuses on organizing office space with the primary focus being on the way that things get laid out to maximize effectiveness and efficiency. The principles of this concept are applicable to most functions within the workplace. The applications are reduce errors, frustrations and stress while at the same time increasing in effectiveness.

From something as trivial as organizing canned goods in a cabinet to something as important as organizing one's desk in their office space, organizational ergonomics knows no bounds. The main focus of Organizational Ergonomics is the items used more frequently an office should be the easiest to find and the most accessible. [3]

2.4 <u>Computer Ergonomics:</u>

Computer Ergonomics is the application of scientific information related to humans to the design of computer systems and environment for human use. The objective is to apply human characteristics to the design of computer-based work environments to reduce problems of people at work.

Computer Ergonomics can be again classified into mainly TWO types. They are:
1. Software Ergonomics (or) Human Computer Interaction.
2. Hardware Ergonomics.

2.4.1 <u>Software Ergonomics:</u> Software Ergonomics is the software that tells you about the different ergonomic exercises. The *Software Ergonomics* will tell you about the stretch at your computer or take a break.

The Software Ergonomics can

a. record details of use on every action a user has enacted on a computer as a log file.
b. stop the computer from working for a period of time after a specified number of keystrokes or mouse-clicks to enforce break periods.
c. display sample animation of exercises or movies showing stretching options.
d. prompt users to take regular breaks.

Some good Software Ergonomics :

Ergonomic Software by work pace

Work Pace software helps workers achieve safe and healthy work habits at their computers by: educating them about muscle fatigue and recovery, alerting them to when micro pauses and breaks are needed, guiding them through regular exercises and stretches designed to reduce fatigue, monitoring their exposure and intensity of computer use and providing them with feedback on how they are doing. [14]

Ergonomic software by Stress Away

This ergonomic software provides solution for

- Headaches
- Stiff Neck or Shoulders
- Blurred Vision
- Gritty-Feeling Eyes
- General Fatigue [6]

PROBLEMS ARISING DUE TO POOR ERGONOMICS IN COMPUTER SYSTEMS:

1. Health Issues Due To

A. Repetitive & Forceful Movements / Vibrations

Health-related problems arise due to vigorous movements, which apply force to the wrist and arms, and in some cases the neck too. This may occur specially when operating a heavy peripheral device, or when using devices repeatedly, like a printer, plotter, graphics tablet, or even a mouse and keyboard

B. Awkward Postures

Awkward postures while working on a computer due to the shape of the chair, the level of the keyboard, the level of the monitor, etc. have serious repercussions on the physical health of a person. These might include neck strains, backaches etc..

C. Noise

Depending on its intensity, noise is invasive in human's working environment. It is considered either strenuous or harmful. It can lead to occupational hearing impairment (a permanent, incurable disability) that accounts for one third of all occupational diseases. Moreover, since it affects the nervous and cardiovascular systems, it can make work more difficult, be a risk and stress factor and it can contribute to the development of various diseases.

D. Temperature extremes

People can be subjected to temperature extremes depending on the type of computer-based environment they are working in (extreme heat, cold etc). These can cause health issues.

E. Insufficient lighting

This is a problem when there is not enough light to view the information on the display, or insufficient light to perform any other computer related task. The result is eye strain and headaches.

F. Glares & Reflections

If protective screens are not used for visual displays, the glare of the screen may cause weakness of eyesight, eye strains etc. [9]

Software Ergonomics is once again classified into

- Micro-Soft Office Ergonomics.
- Graphical User Interface Ergonomics.
- Web Ergonomics
  - Search Engine Ergonomics.
  - Browser Ergonomics.
- Social Networking Website Ergonomics.

2.4.1.1 Ergonomics features in MS Office :

MS-Word is used to create a document. It is equipped with various tools to provide good designing facilities with predefined symbols and shapes etc.,(to draft letters, drawings etc.). MS - Word of MS – Office version 2007 helps to reduce the strain of the user and improves the efficacy of the performance.

MS – Excel is a spread sheet package. It is suitable for calculations. It allows the user to open any number of sheets at the same time. It is supported by a rich collection of built – in functions to do calculations on Mathematical, Statistical, Financial and Logical Aspects. The Ergonomics aspects are : generating different charts for the same selected data group by a little operation.

MS – Power Point is mainly designed for presenting any information in the form of slides. Presentation of these slides can be customized. The main advantage is it can easily included Data, Text, Graphs, Audio and Video slides without the loss of any kind of information. [8]

2.4.1.2 Graphical User Interface Ergonomics: The main ergonomic recommendations to be checked by the controls in a graphical interface. These recommendations are mainly derived as for instance, we cite:

Writing font: font with which the text is mentioned in the component (Button name, Text-Box text field content ...).

Writing Size: the retrial that includes the writing size (Label, Button text ...).

Writing Color: the writing color to ensure clarity and readability while information displaying.

Components Dimension: the graphical controls and the image must be clearly visible, and do not occupy much space in the GUI; they should be neither too large nor too small. They must meet the GUI proportion.

Text Length: it's preferable to have clear and concise text fields.

Image Density: the interface must not be overloaded with images. only few images and icons to facilitate the GUI use are appreciated.

Global Density: the GUI should not be overloaded with controls, the user can navigate easily.

Baground Color: The use of dark background may cause problems of legibility in the interface information.

Cancel Button: in each window, the user must have the possibility to return to the previous step and cancel the performed action. Thus, we must find buttons that make this possible. [10]

2.4.1.3 <u>Web Ergonomics:</u>

Mozilla Browser: Firefox (Mozilla) is open source software and its source code is visible to all the users. This allows users to review the code for security vulnerabilities, whether their intentions are good / malicious. This browser support many features like * Tabbed Browsing, * Private Browsing, * Smart Keywords, *Spell Check etc..

Opera Browser: It is one of many popular web browsers in web application. It is supported by many good features like *Reload Information, *Duplicate the tab, *Rewind, *Crash Recovery etc...

Google Chrome Browser: This web browser is very effective in view of multi tabs and buffering aspects. Apart from the normal features it is supported by various aspects like *Task Manager – to indicate memory and CPU usage for all the open tabs, *One Box for Search, Address and History, *Upgraded Tabs – user can brag a tab into its own window and drag it back to the main window called as "Dynamic Tabs", *Incognito Browsing, includes an Incognito mode in which users can go to sites but get nothing from that session – history, form fields or cookies. [7]

Internet Explorer Browser: Internet Explorer (IE) is the most widely used web browser in the world. It has many features such as *Tracking users recently visited sites, *Setting up shortcuts to user favourite sites, *Protecting users personal information, *Displaying sites in different languages, and *Customizing users own preferences for how users access web sites.

2.4.1.4 <u>Social Networking Websites Ergonomics:</u>

Social Networking Websites that allow the creation of content by users or communities have become popular in recent years. The content of these sites can be virtually anything: Blog entries, message board posts, videos, audio, images, wiki pages, user profiles, bookmarks, events, and so on. Each content item on a Website can be a source of creating links not only between people, but also between people and content, or among content items. From this perspective, this content can enhance social relationships among participants who have an underlying shared interest within a community.

Ergonomics guides how to design equipment for providing well – beings to the users under safety environment. An Ergonomically designed system gives comfort to the user to work efficiently for a longer period with lesser fatigue. Ergonomics can be found at three – level – Structural level : i.e., Seating and structure of equipment, Software level – provides more utilities for easier and faster usage, User – level – for physiological aspects of the user, like body posture etc., [11]

2.4.2 <u>Hardware Ergonomics:</u>

Many design decisions must take into account the needs and requirements of the human users involved; this is the province of ergonomics. The user may be the operator of the equipment or system during normal circumstances, the maintenance specialist who has to deal with unexpected situations, the commissioning team responsible for a large system, and indeed anyone who will be relying on the equipment (perhaps from the managing director using his desk-top computer to the consumer with his new piece of household apparatus).

A user can interact with the system by giving data or set of commands (Mouse). In order to do these commands user should utilize different hardware components like Keyboard, Mouse, Monitor, Joystick, Printer etc. [12]

3. Conclusions

Computer Ergonomics is a fast emerging arena, which involves study of handling many problems of stress injury due to bad ergonomic design of machines, bad usage of the devices and bad environmental conditions. Basically, computer users can promote paperless office. Usage of paper can cause environmental problems unless proper care is taken. An old paper degenerates and invites mites and other insects. Nevertheless, long-term continuous computer usage could lead to stress injury problems. This paper has discussed about taxonomy of Ergonomics and various aspects regarding ergonomics.

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