ERGONOMIC FACTORS CONSIDERED IN INFORMATION SYSTEMS IMPLEMENTED IN KENYA: THE CASE OF FIRMS IN NAIROBI

BY

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DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

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This research project has been submitted for examination with my approval as University supervisor.

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DEDICATION

*To the **Almighty God**, for making this project possible, and to **my dear wife, Bernadine** and **our beloved children** for their constant support and prayers that have made this project a success.*

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ABSTRACT

The focus of this study was to determine the relative importance attached to ergonomic factors by IT consultants, their actual consideration of ergonomics factors, and constraints to the actual consideration of the same factors in the information systems that they implement in Kenya. The need for this study arises from the fact that whereas ergonomics need to be considered in information systems implemented, the state of ergonomics considered in Kenya is not known. Thus, this study was timely and would provide a foundation for further research on computer ergonomics, in information systems implemented by IT consultants in Kenya.

With the increased number of activities that demand the use of computers, there is an expected increase in computer usage and work related human health problems unless ergonomic factors are considered. In respect of this, the study addressed the following questions: 1) What level of importance do IT consultants attach to computer ergonomic factors? 2) What ergonomic factors do IT consultants actually consider during implementation? 3) What are the factors that inhibit the implementation of ergonomic factors? IT consultants were chosen as the respondents in this study because they play a key role in implementing computer-based information systems, hence in sensitizing the end-users about the need for

computer ergonomics consideration in their information systems. They are also expected to integrate ergonomics into the information systems they implement.

Data for this study were collected from a population of 77 IT firms in Nairobi, Kenya, using self-administered questionnaires. Of the 77 questionnaires given out, 41 were successfully filled and collected. The data obtained pertained to the level of importance attached to ergonomic factors by IT consultants, the ergonomic factors actually considered during information systems implementation and the constraints that hindered the implementation of the ergonomic factors. These data were subjected to analysis through descriptive statistics with the aid of a statistical package for social sciences (SPSS).

The results overall revealed that most of the IT consultants considered ergonomic factors as extremely important, and this importance varied from one ergonomic factor to another. For example 36.6% of the IT consultants considered anthropometrics as extremely important compared to 4.9 % of the same consultants who considered them as not important at all. Also, 70% of the IT consultants considered climate as extremely important compared to 4.9% who considered it as not important at all. The results also

revealed that most of the IT consultants actually considered ergonomic factors in the information systems they implemented. This again varied from factor to factor. For example 95.1% of the respondents actually considered lighting in their installations compared to only 4.9% who did not, while 92.7% actually considered climate compared to 7.3% who did not.

Constraints that hindered the actual consideration of computer ergonomic factors were also provided for in the questionnaire. The constraint, " the development, resource and implementation costs" was encountered as the most common constraint, with change training posting the highest responses of 56.1% of the total responses, while software design posted 7.3%, the least responses for the same constraint. The second highest constraint was "'play down' on the impact of the ergonomic factors", which had shift work and work surface recording 37.1% each. Support systems had the least posting of 7.3 for this factor. The least considered constraint was the "presence of inflexible information systems", which had anthropometrics as the highest recorded ergonomic factor (22%) that was inhibited by this constraint and most of the ergonomic factors recording a response of 2.4% for the same constraint. These were, biomechanics, change training, climate, furniture design, management systems physical and work surface.

Though conclusions reached were general and tentative, overall, they appeared to suggest that most of IT consultants in Nairobi, Kenya find ergonomics extremely important and actually consider in the information systems they implement albeit the constraints.

CHAPTER I

1.0 Introduction

1.1 Background

The last two decades have been characterized not only by increasing reliance on computers, but also on their worldwide interconnectedness. Managers have become more and more reliant on computer-based information for decision-making. These developments are accounted for by a number of factors that have affected the business environment.

Firstly, there has been the emergence and the strengthening of a global economy. In global economy, there is a growing dependence on imports and exports among advanced industrial economies in America, Europe and Asia. Firms in such economies rely on international trade and their success depends on their ability to operate globally (Laudon, 2000). Globalization of the world's industrial economies has greatly enhanced the value of the information in the firm and it is offering new opportunities to business. For example, firms like airlines and hotel chains that have customers who travel widely or even have global operations, will need global information technology (IT) capabilities for online

transaction processing so that they can provide fast and convenient service to their customers. Information systems have to provide the communication and analytical power that firms need in order to achieve this goal. This in turn calls for intensive use of computers, whose responses and processing speeds have greatly improved (O'Brien, 1993).

Secondly, there has been an increase in complexity in the business environment. A complex business environment, is one that is so dynamic that competing firms have to continually scan their environment, for strengths, weaknesses, opportunities and threats, while at the same time working for more sophisticated customers (Porter, 1985). This complexity is aggravated more by the emergence of digital economy, which totally utilizes IT in its economic activities and consequently brings a fundamental change the activities and business environment as such. Many firms have to transform themselves to adapt to the changing business environment (Han, 2001). This adaptation includes IT integration into business operation in order to see how, where and when they should take advantage of the competitors' weaknesses, while at the same time making proper use of their strengths and opportunities, many firms are adopting innovation based on IT to compete in the world markets (Laudon, 2000).

Thirdly, increasing customer sophistication has greatly altered the business environment. Customers are now more demanding in terms of the quality pricing of the products and services they need. To take care of this demand, firms have to attractively package such products and services using innovative technology to meet the need of these users (Kotler, 1997). This packaging has been made easier by use of IT. No doubt Laudon (2000) points out that, to become profitable participants in international markets, firms need powerful information and communication systems to facilitate the customer sophistication.

Fourthly, industrial economies like the United States of America, Japan and Germany, are being transformed from agrarian economies to knowledge and information based economies. Today most people have moved from working on farms or even in factories and have ventured into blue and white-collar jobs, which tend to be information intensive. Besides this, many new services and products have their origin and foundation in knowledge and information systems. No doubt, there has been a notable increase in the intensification of knowledge and information utilization in the production of traditional products, leading to shorter product life cycles. These developments together with time-based

competition have led many firms to seek solutions in information systems and technology (Laudon, 2000).

The fifth factor affecting the business environment relates to changes in the organization and management of firms. Firms, many of which had hierarchical and centralized organizational structures, with emphasis on specialists working on fixed sets of standard operating procedures, are changing to more flattened and decentralized structures, with flexible "generalists" that rely on nearly instant information to deliver mass-customized products and services uniquely suited for specific market niches and customers (Laudon, 2000). This instant information delivery has been made possible by increased use of IT in the firms and has resulted in an increase in computer usage.

The sixth factor that has caused changes to the business environment is the growth of the Internet, intranets and extranets. Reisman (1997) defines the Internet as the public, global network of networks, which is based on the Internet Protocol (IP) and related standards. This technology was designed to provide a standard means of interconnecting networks so that any system could communicate with any other system. Reisman (1997) defines the intranet as a private application of the internetworking

technology, software, and applications in respect of the Internet within a private network, for use within an enterprise. An extranet, on the other hand, is a network that uses the Internet/intranet technology to serve an extended enterprise, including defined sets of customers or suppliers or other partners (Reisman, 1997). Increase in usage of this technology has resulted in an increase in the computer usage.

Evidently, IT is bringing about changes in organization that make the firm even more dependent on computers than in the past. This has in turn led to proliferation as well as an increase in the usage of computers in firms, and even at homes for sophisticated consumers. Table 1.1.1 demonstrates an increase in computer usage and networking, over the last 20 years.

Global Technology Trends (PCCIP,1997)			
What	*in 1982*	*in 1996*	*in 2002*
Personal computers	thousands	400 million	500 million
Local Area Networks	thousands	1.3 million	2.5 million
WWW devices	none	32 million	300 million

Table 1.1.1 The global technology trends, adapted from, PCCIP (the President's Commission on Critical Infrastructure Protection). Critical Foundations; Protecting America's Infrastructures. 1997.

Increased computer usage, however, can have serious impacts, which if unchecked, would be harmful to the users. For instance

an increase in the computer usage leads to an increase in the user interaction with the computers. Increased computer usage may require that the user be seated on a computer for long hours, either to complete job tasks, or even to do addictive activities, such as surfing the Internet. If unchecked, this behaviour, together with lack of proper rules and procedures to be followed on the computer usage, there will be increase in incidences of certain physiological and psychological conditions that may affect the productivity of an individual. Improper and unchecked use of computers has, in fact been shown to cause such conditions as repetitive strain injury (RSI), musculoskeletal disorders (MSDs), eyestrains and eye stresses to the user and even harm to the unborn (Charlotte, 1983). RSI is a term used for a number of overuse injuries affecting the soft tissues (muscles, tendons and nerves) of the neck, upper and lower back, chest, shoulders, arms and hands, caused by a variety of factors including repetitive action, force and awkward or static postures.

It is therefore very important that measures are taken to reduce or even curb the improper computer-usage cases of injuries. Such measures include the consideration of the computer user interface, including design of jobs, health issues and other relevant issues. All these constitute the ergonomics issues.

1.2 Ergonomics

Ergonomics is the science of fitting jobs to people rather than forcing them to contort to fit the job. Laudon (2000) defines ergonomics as the interaction of people and machines in the work environment, including the design of jobs, health issues, and the end-user interface of information systems. The goal of ergonomics is to design a workstation environment that is safe, comfortable and pleasant to the user. This would lead to reduced cases of work related illnesses.

O'Brien (1993) broadly classifies ergonomic factors into three main groups, which are: the tools that include computer, hardware and software; the workstation and environment; and the task that includes the job content and context.

Ergonomic factors, can well be considered and implemented within the systems development life cycle (SDLC). The SDLC is a traditional method for building information systems that is still being used today, especially in medium and large complex systems projects. It divides the systems development process into formal stages that must be completed sequentially with clearly defined

tasks for both the end-users and information systems specialists. The SDLC stages tend to vary in number, the terminology used and in the order in which they are executed. According to Laudon (2000), it may be formally divided into six divisions, which are the project definition, the systems study, systems design, programming, installation/implementation and post implementation stages. O'Brien (1993) on the other hand, gives five stages. These are investigation, analysis, design, implementation and maintenance.

Generally most firms resort to IT consultants whenever they intend to develop their information systems, making them computer-based. Thus for ergonomics and their impacts to be considered, the consultants must be aware of the existence of ergonomics and the consequences of failing to consider them while implementing information systems. Further, the consultants should consider the ergonomic factors and in fact implement them when developing information systems. Consideration of the ergonomic factors needs to be taken care of in all the stages of the SDLC.

Firms must take into account ergonomic consideration for three reasons. Firstly, they have no choice but to consider ergonomic factors, as there is high possibility of related legislation. Secondly,

the funds spent on improving the ergonomic acceptability of workplace have been shown to have an excellent return on investment. Research in the developed world shows that failure to consider ergonomics has resulted in high medical claims, low productivity and even high absenteeism and truancy among workers due to major health disorders (Hopkins, 1995). On the other hand, the studies in the developed countries have shown that ergonomically designed computer workplaces were able to contribute to reduced incidences of the health disorders (Nordin and Frankel, 1989). Thirdly, adverse implications of failure to consider ergonomics would be mitigated (Schneider, 1985).

1.3 Statement of the problem

This study concerns ergonomic factors as related to information systems implemented by IT consultants in Nairobi, Kenya. The increased computerization of firms has been a phenomenon in Kenya as it is globally. The increased computerization with the resulting increased computer usage, if unchecked through computer ergonomics consideration, can lead to increased cases of work related illness and reduced productivity. For the benefit of the computer users, computer ergonomics must be considered in totality in order to reduce or curb these cases. This requires

knowledge of ergonomic factors, their fair consideration and treatment, and the elimination or mitigation of the constraints to ergonomic factor consideration. Given that ergonomics is a common phenomenon, IT consultants generally know and appreciate it. However, it is one thing to know and another to value it appropriately. Also, an ergonomic factor considered significant might end up not being considered for implementation for some reasons or constraints. As most firms rely on IT consultants for implementing computer-based information systems in Kenya, consideration of ergonomics in information systems development then tends to be vested mainly in the IT consultants. In view of these facts, the following questions arise: What is the relative importance that the IT consultants attach to the ergonomic factors? Which ergonomic factors do the IT consultants consider when implementing information systems? What constraints do the IT consultants encounter when implementing ergonomic factors in the information systems they implement? To the best knowledge of the researcher, no such research has been done in Kenya. This is obviously expected given the relative newness of the phenomenon in Kenya.

1.4 Objectives of study

Given the research problem, objectives of the study then are to determine in respect of IT consultants in Nairobi, Kenya:

a. The relative importance of the ergonomic factors they consider when implementing information systems.
b. The ergonomic factors they actually consider when implementing information systems.
c. The constraints to the consideration of the ergonomic factors.

1.5 Importance of the study

The findings of this study would be of interest and value to various persons as follows:

(a) The study would provide information that would be useful generally to the Government of Kenya in the design and implementation of health policies directed to ergonomic factors considered in computer based information systems.

(b) The study would be useful especially to the ministries involving health and labour that develop programmes to improve working conditions for employees. They would use the findings of the study in developing policies on what

action to take with respect to the condition of employees who are heavy computer users.

(c) The study would enlighten trade unions on some information on the state of consideration of ergonomics in the computer workplace. They would use this in bargaining for better employee working conditions and terms.

(d) Scholars would use the results of the study to further research in ergonomics as relating to computers-based information systems.

(e) The study would give added information on ergonomics to computer trainers and training institutes endeavouring to implement ergonomics in their schools.

(f) The Kenya Computer Society could find the result of the study valuable in developing guidelines for enriching the job regulations for computer users and consultants.

(g) The results of the study may be useful in inauguration - if need be - of an institute of professional ergonomists that further the adherence of ergonomics in information systems implementation.

1.6 Overview of the study

This project has five chapters as follows:

Chapter I: This is the introductory chapter. It comprises the background of the study, the statement of the problem, the objectives and the importance of the study.

Chapter II: This chapter is devoted to a review of literature that is relevant to the study. First, it gives consideration to the increase of computer usage in the world and in Kenya in particular. Secondly, it considers the ergonomic factors and how they relate to increased computer usage. Thirdly it looks at ergonomic related health issues. Fourthly, it looks at the ergonomics and other considerations with a view to reducing the related injuries. Finally it looks at the constraints that hinder the consideration of ergonomics.

Chapter III: This chapter covers the research methodology of the study, covering the population, data collection and data analysis methods.

Chapter IV: This chapter contains data analysis, discussions and the findings of the research.

Chapter V: This chapter presents a summary of the research findings, conclusions, suggestions for further research and the limitations of the study.

CHAPTER II

2.0 Literature Review

2.1 Current state of computer usage

Over the last period spanning over a decade, computers have dominated the world, and firms are fast in adopting them to their information systems. This is expected as computers become more and more affordable, with the advantages that computer manufacturers are taking of very large scale integration (for smaller powerful computers) and economies of scale (of many units of computers being manufactured in order to meet the growing demand). With computers becoming more and more affordable, so also is their exploitation spreading, and the individuals finding themselves obligated to be computer literate (Mirani, 1993). Linkages of computers through networks have also increased greatly over the past decade, further improving on the provision of information and reinforcing the trend due to the cost cutting capabilities that computers have brought (O'Brien, 1993). Apparently, in connection to this computer usage and influence have become pervasive and have expanded to cover corporate organization and structure, product development, customer relations, employee satisfaction, retailing and marketing. Also, the

growth of computer literacy has been radical, leading to the spread of computer usage from the firms and large organizations to smaller offices and homes. (Reck, 1987).

The growth of IT with associated communication technologies such as electronic commerce, the Internet and so on, has fundamentally changed the way we do business, communicate with our clients, market our products, source and find buyers. The growth has spread from US to the rest of the world at large. For instance, of the users constituting Internet traffic in 1995, only 23% of them were outside the US, and by 2000 that share had increased to about 50% (Hickman, 1997).

The growth of IT has also eliminated monotonous or obnoxious tasks in the office and the factory that was normally performed by people. IT applications such as word processing and desktop publishing for example have made producing documents a lot easier. Other IT applications such as the use of robotics in factories have taken over repetitious wielding and spraying jobs in the automobile industry. To this end, IT apparently has upgraded the quality of work because it can upgrade the quality of working conditions and the content of work activities. However, IT has also created jobs like data entry, that are quite repetitive and routine,

and some assembly line operations that require an assembly line operator to continually perform elementary repetitive tasks mostly for long hours in the same working position and posture (O'Brien, 1993). To this end, it poses health related problems.

In Kenya, over the last few years there has been a visible increase in computer usage especially with the developments surrounding the Internet applications. One such development is the "e-touch" facility introduced by AfricaOnline, an Internet service provider (ISP). The "e-touch" facility is aimed at providing e-mail and Internet browsing facilities to as many Kenyans as possible, by strategically positioning a number of browsing facilities in premises in various metropolitan areas. In addition to the developments related to the Internet, there has been an increase in the number of computer bureau services to provide computing services to end-users in public. Further, many firms in Kenya are continually computerizing their information systems leading to many of them making the users totally dependent on computers for purposes of communications, both internal and external, and the normal office activities.

The increase in computer usage, together with the desire for quick, inexpensive results, may lead to proper consideration of the user

interface in designing and implementing information systems being overlooked (Turner, 1997). To get around this situation greater attention should be paid to ergonomic factors.

2.2 Ergonomic factors.

Ergonomics is the proper design of the work environment to address the physical demands experienced by workers. The term comes from the Greek *ergon*, meaning, "work" and *–onmics* meaning "management of". Prichard (2001) says that ergonomics is the only branch of engineering that addresses the issue of product usability. This realm of science is a component of the study of the capabilities of humans, mental and physical, known as human factors. A person in charge of ergonomics is an ergonomist. Such a person studies physiological, psychological and engineering design aspects of a job, including such factors as fatigue, lighting, tools, equipment layout, and placement of controls (O'Brien, 1993). This way ergonomics could be integrated into the work environment.

O'Brien (1993) breaks down ergonomics into three groups of factors: the tools, the workstation and environment, and the tasks. The three groups are in turn into various ergonomic factors, as shown in the Figure 2.2.1.

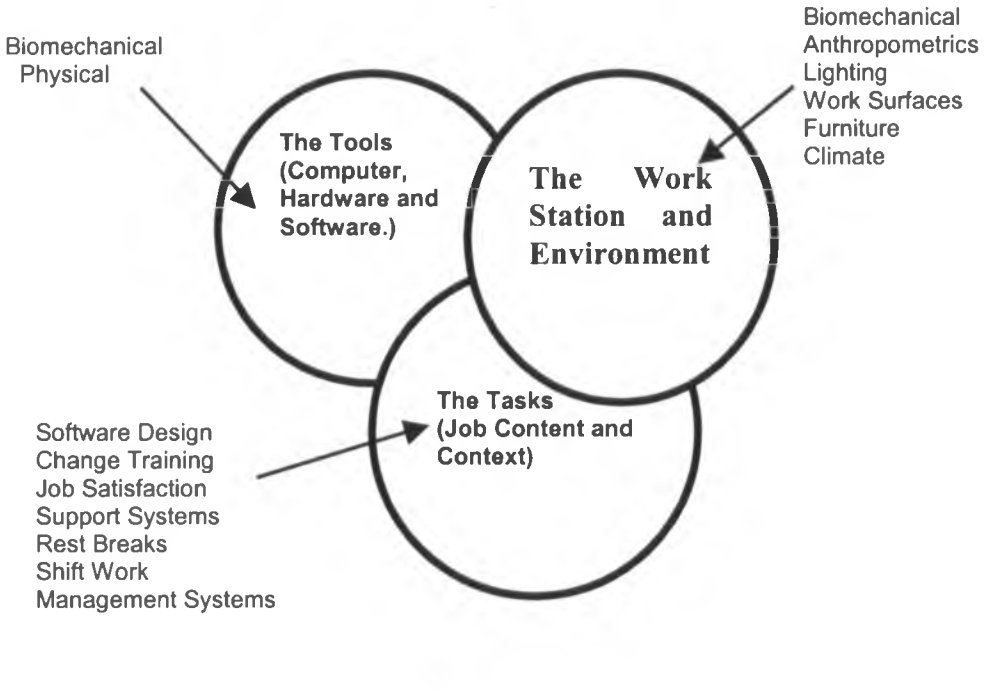


Figure 2.2.1 Ergonomic factors in the workplace. Adopted from James O'Brien, Management Information Systems; A Management End User Perspective, 1993

The factors are discussed as follows:

Anthropometrics is the science of body size measurements. In order to fit the task to the worker, knowledge of human dimensions is necessary. During the systems study stage, this information can be collected and used to design workstations, equipment, tools, and personal protective equipment to accommodate the users' physical dimensions, during the design stage.

Biomechanical factors are those mechanical properties of human tissue, concerned especially with the response of tissue to mechanical stress. In response to some sort of physical activity, muscle tendons develop forces. These forces act on bones at their

points of insertion and cause rotation or torque around a joint. By understanding the mechanism of a job task, the concept of biomechanics can be applied to identify, correct, or avoid injury (Nordin and Frankel, 1989). Obviously, this is when the job is being done.

Climate covers the entire concern about the working environment in terms of air-conditioning, heating and ventilation, that makes the environment conducive to the workers. This factor can be integrated into the information systems design in SDLC.

Furniture is the entire set up of the computer workplace, including chairs, computer desks and so on. Furniture should be designed with the capability for the worker to adjust it whenever necessary as the most important issue. To the worker, this will ensure a comfortable working environment (Haslegrave, 1994).

Work surfaces are those surfaces on which the computer hardware especially the keyboard, mouse and other input and output devices are placed during the work session. They should be designed for end-user safety, comfort and ease of use (Haslegrave, 1994).

Jobs are those defined tasks - content and context - that the worker performs. Jobs should be designed to accommodate job rotation, shifts and work breaks, which should be given often to reduce the contact time with computers. In addition, frequent training especially on change programmes is needed. This apparently is to enable workers to safely adapt to new jobs resulting from the change. Further, computer related hazards such as exposure to cathode ray tube emissions should be avoided.

Lighting defines the amount of illumination in the workplace. Too much of it, as well as too little of it is sensitive to the eyes. Efforts should be taken to provide for adequate lighting in the work area.

Software design brings the issues of graphics on the video display unit and how this can make the work attractive to the worker. Software can be designed in such way that it elates the computer user and encourages him to work. Use of macros and function keys for repetitive keystroke activities that reduce repetitive tasks also improve working environments.

Management systems are those that involve the use of office partitions, privacy filters like antiglare filters, for computer screens, password, etc to enhance privacy on the computers.

The physical factors are those that ensure sufficient availability and type of space to comfortably accommodate all users expected to be working in the area.

Availability and placement of support systems like printers, fax machines, coffee/tea dispensers and so on, within the works area for ease of reach by the worker, while in working position.

Placement of working implements like pens, erasers, phones, mouse and so on, on the working surfaces within comfortable reach by user when required.

2.3 Studies undertaken on ergonomics.

Several ergonomic studies have been undertaken in developed countries. Somewhat, given a lot of attention in the studies, are repetitive strain injuries (RSI) and other related problems. Research in the developed world has shown that, poor workplace and job design are significant factors in the development of RSI and musculoskeletal disorders (MSDs), and other presentations like eye stress/strain and electromagnetic emission effects from cathode ray tubes (CRTs). Repetitive strain injury (RSI) is a term used for a number of overuse injuries affecting the soft tissues

(muscles, tendons and nerves) of the neck, upper and lower back, chest, shoulders, arms and hands, caused by a variety of factors including repetitive action, force and awkward or static postures. Brogmus (1996), on the other hand uses the term *Cumulative trauma disorders of the upper extremities* (CTDUEs) to describe the same collection of painful impairments affecting any part of the body from the fingers to the base of the neck and having as a contributing cause repetitive manual work. It is therefore very important that measures are taken to reduce if not to eliminate these cases of injuries. Typically arising as aches and pains, these injuries can progress to become crippling disorders that prevent sufferers from working or leading normal lives, leading to reduction in productivity (Charlotte, 1983). Statistics available from the US Bureau of labour statistics (Jan/Feb 1998) indicate that repetitive back disorders (not including back injuries) accounted for 62% of all reported cases of works related illnesses in 1995, and had increased 14 fold from 1972 to 1994. The number of reported back disorder cases in 1995 actually was lower by 7%. This however, still exceeded the number of cases in any year prior to 1994. Despite their increasing prevalence, workers, employers, the medical profession and others poorly understand these injuries. In addition, getting appropriate diagnosis, treatment, compensation

and workplace accommodation is often difficult and places a further burden on the injured worker (BLS, 1998).

Other studies in the developed countries have shown that ergonomically designed computer workplaces were able to contribute to reduced incidences of the health disorders (Nordin and Frankel, 1989). On the other hand, research in the developed world shows that failure to consider ergonomics has resulted in high medical claims, low productivity and even high absenteeism and truancy among workers due to major health disorders (Hopkins, 1995). These factors may not be tangible but they certainly inhibit performance. The direct economic impact of improving human productivity in the office is quite large. In fact studies show that a more comfortable, non- stressed worker can be up to 3 times more productive (BLS, 1995). The same report showed that when aspects of quality of work life such as job satisfaction, is improved, it improved employee morale and led to reduction in employee turnover (BLS, 1995).

There is no known research to the researcher, in Kenya that has studied the factors in information systems development. Fairly related researches undertaken in Kenya so far are by Ochieng (1998), Kipngetich (1991), Nyambane (1996) and Gatune (1993).

Ochieng looked at the factors important for successful implementation of information systems, in the baking sector in Kenya. Kipngetich studied the management satisfaction with information systems, Gatune studied factors considered in implementing local area networks and Nyambane addressed the extent of the factors limiting IT usage in publicly quoted companies in Kenya.

2.4 Health issues.

The safety aspect of the information systems implementation becomes a real issue especially when the systems are to increase performance and productivity.

In order to appreciate the effects of the safety aspects in performance and productivity, there is a need to understand the basics of safety in relation to the workplace health issues. Related to these are occupational injuries and illness, industrial accidents and the use of IT in the workplace.

According to Miner and Crane (1995), an occupational injury is any injury such as a cut, fracture, sprain, strain or amputation, which results from a work event or from a single instantaneous

exposure in the work environment. Occupational injuries and illnesses include:

a. Occupational deaths, regardless of the time between injury and death or the length of the illness.

b. Non-fatal occupational illnesses.

c. Non-fatal occupational injuries that involve loss of consciousness, restriction of work or motion, transfer to another job or medical treatment other than first aid.

An occupational illness is an abnormal condition other than one resulting from occupational injury caused by exposure to factors associated with employment including acute or chronic illness or disease caused by inhalation, absorption, ingestion, repetitive jobs or direct contact (Miner and Crane, 1995). Included in occupational illnesses are musculoskeletal disorders (MSDs). Edward Emmett (1991) gave some examples of MSDs as repetitive strain disorders and acute injuries and occupation eye diseases like cataracts and others. Resulting lost workday cases involve days away from work or days of restricted work activity, or both (Miner and Crane, 1995). The number of lost workdays is taken as the total of all days that the individual would have worked (not including the day of onset of injury or illness), but could not

because of occupational injury or illness and/or the total of all days on which, because of injury or illness, the employee:

a. Was assigned to another job on a temporary basis.

b. Worked at a permanent job less than full time.

c. Worked at a permanently assigned job, but could not perform all duties connected with it.

Peskin and McGrath (1992) listed notably 10 factors commonly known to cause industrial accidents. These are: poor worker training, inability to do the job, lack of understanding of the job, improper tools and equipment, poor quality materials, poor equipment maintenance, poor working environment, incorrect shop routing, tight work standards and overly tight scheduling

The use of IT in the workplace raises a variety of health issues. Heavy use of computers is reportedly causing health problems like job stress, carpal tunnel syndrome, damaged arm and neck muscles, eyestrain, radiation exposure and even death by computer caused accidents. Workers, unions and government officials criticize computer monitoring as putting so much stress on employees that leads to health problems (Dejoie, Fowler and Paradice, 1991, Dunlop and Kling, 1991). This is justifiable, as it would force computer users to spend more time on computers. Yet

people, who sit at PCs or visual display units in fast paced, repetitive keystroke jobs, can suffer a variety of health problems such as cumulative trauma disorder or repetitive strain disorder. Some of them even suffer carpal tunnel syndrome, a painful crippling ailment of the hand and wrists, which typically requires a surgery to cure (Betts, 1990). Further, staying close to video displays for long may cause another health concern. Video displays produce an electromagnetic field, which may cause harmful radiation of employees who work too close and for long times in front of video monitors. It has also been proved that some pregnant workers have reported miscarriages and foetal deformities said to be caused by prolonged exposure to CRT (Savage, 1991)

Carpal tunnel syndrome has existed for some years but its incidence appears to be increasing as a result of a lot of RSI. Carpal tunnel syndrome is an injury common to people who put their hands through repetitive motions such as typing, playing some musical instruments, cutting or sewing. The motion irritates the tendons in the "carpal tunnel" area of the wrist. As the tendons swell, they squeeze the median nerve, resulting in pain and numbness in the thumb, index finger and middle finger. The hands of the victims become clumsy and weak. The pain increases

at night and at advanced stages, not even surgery can cure the problem. If no timely treatment is taken, victims eventually lose feeling in their hands (Betts, 1990).

Back, neck and leg stress problems are also expected with heavy computer usage. When the head is balanced over the shoulders during a users work session, muscles in the neck easily adjust. However, when the head is tilted forward or backward, the muscles in the neck are over stretched, exposing the worker to back, neck and leg stress. Having the video displays placed in improper positions causes this problem (Mill, 1994).

Eyestrain, or burning or itching of eyes is a major complaint from users working on computers. Ergonomics experts advise that lighting is one of the usual causes. The human eye refreshes itself by blinking several times per minute. When user is staring at a screen, the blinking rate decreases, which makes the eye dry and itchy. Other contributing factors can include non-adjustable workstations (that keep reading material too far away), poor image quality on computer monitors, and sources of glare and shadows. Some subject specialists implicate poor job design that results in long periods of working on

the same task. Some solutions that are often recommended include the use of portable lamps to allow each employee to adjust lighting levels to personal preference, and against computer screen glare that often results from sunlight or inappropriate lighting levels. The glare may be reduced with the use of louvers, baffles or indirect lighting. Windows could also be covered, perhaps with blinds, drapes, shades or filters to help in reducing reflection on the monitor.

Today's office work is definitely the source of some primary health and safety issues. Most of these issues are a variation or a result of RSI sustained from repeated strain such as typing on a poorly positioned keyboard, lifting heaving objects again and again, or reaching for objects from an awkward position. Such repetitive stress on the hand has led to a 25% increase in this category of occupational injuries in the last decade. RSIs now constitute 56% of all occupational injuries according to the US Labour Department (Pascerelli and Quitler, 1994).

2.5 Ergonomic and other considerations

In order to deal with the health issues related to computer usage and consider ergonomics in the wider sense, various programmes and approaches have been recommended. Some of these include:

a. Safety committees which are usually made up of managers who are charged with the responsibility of setting rules, investigating special problems, approving expenditures and resolving disputes. Success of these committees varies considerably, and is not guaranteed. A major problem with this has been the inability for the union and management representatives to work together toward the success of the committees (Sheehy and Chapman, 1987).

b. Safety training, which should be offered in addition to skill training to new and unfamiliar employees whenever there has been an introduction of any new tool. The training should include instruction on how to deal with special hazards, frequent accidents, use of safety equipment, safety rules and procedures, available medical services and reporting procedures that explain and guide the employees on the activities of the firm. The instructional approaches used in safety training vary widely, but procedures related to

behaviour modeling have proved more effective (Sheehy and Chapman, 1987).

c. Safety promotions, where various modes of information dissemination are used to promote awareness of the importance of safety. Promotions may be in form of booklets, memoranda, articles in company publications, posters, stickers, handouts and so on (Ochieng, 1998).

d. Controlling the work situation by eliminating dangers in the work environment and/or screening people from them. An ideal situation is to design the job so that a source of injury or illness is removed completely from the workplace. The challenge in this approach is to find a way of making it almost impossible for a person to be actually exposed to the threat.

e. Inspection and discipline. Miner and Crane (1995) depicted the injury process as shown below.

Figure 2.5.1 The injury process, Depicted by Miner and Crane (1995)

Inspections tend to focus on the segments of this process that precede the injury. These tend to be more effective in identifying unsafe working conditions than unsafe acts or

behaviours. If designated unsafe working conditions are not corrected, then discipline is highly likely. Inspections should be pro-active.

f. Selection and Placement. People who are more susceptible to harm due to their poor health, gender or status, may have to be placed in areas where they are safe from the factor. This should be considered during selection of potential employees. By performing personality tests, it is possible to identify those people who have a substantial likelihood of having accidents (Jones and Wuebker, 1993). These people should be screened and if possible should not be employed at all.

The above programs fall basically under two approaches to safety, which are, the engineering approach and the behavioural approach.

In the engineering approach to safety, workplace accidents are normally checked by making sure that equipment and work areas are designed in such a way that workers who loose concentration periodically, or who perform potentially dangerous jobs, cannot injure themselves or others. Providing safety equipment and guards on machinery and installing emergency switches around the work area is therefore important. Others may include

installing adequate ventilation, lighting, or heating and air-conditioning in order to make the environment safer (Miner and Crane, 1995).

The behavioural approach to safety involves the industrial psychologists, who are concerned with the proper match of people to jobs, emphasis on employee training methods, fatigue reduction and health awareness. Studies have shown that there is a definite relationship between emotional factors, such as stress, and accidents (Miner and Crane, 1995).

In addition to these two approaches to safety, another approach to safety concerns ergonomics. The goal of ergonomics is to design healthy work environments that are safe, comfortable and pleasant to work in, thus increasing employee morale and productivity. Ergonomics stresses the healthy design of the workplace, workstations, computers and other machines and even software packages.

Ergonomics could be integrated into information systems as follows:

Anthropometric factors are those that deal with the body dimensions of the human being. The uniqueness of each individual and the wide variety in age, gender, shapes, sizes, and capabilities

in which human beings can come, make it complex in application. When these aspects are considered in information systems implementation, they reduce the risk of the injuries.

Biomechanical factors are important and can be taken care of by reducing the repetitive tasks at the design and programming stages. This can be done by designing macros and programming function keys, to be used instead of repeatedly pressing the same keys all the time one wishes to perform these tasks.

Job design is also an important issue emphasized by ergonomics. This may be for example by having policies that may provide for work breaks every few hours for heavy video display terminal users, while limiting CRT exposure to pregnant women (Attaran and Haut, 1989). This study is looking at this approach to safety.

Temperature, humidity and air movement can all contribute to employees' lack of comfort. These aspect fall under the climate factor. Unfortunately, as the experts point out, office ventilation systems are complex and often not adjustable by workers.

Other examples of problem spots cited in this area of ergonomics include computer stations, photocopiers and other heat-emitting equipment—which can increase indoor temperatures to uncomfortable ranges. Placement of these support systems is crucial in a work place.

Ergonomic specialists caution that even interesting tasks can get boring over long unrelieved periods, and the most comfortable furniture cannot compensate when someone has to sit in it for hours. They also observe that working overtime with the stress of deadlines can make people tune out how they feel (and thus not try to relieve it).

Advising employees to change posture frequently, stretch periodically and punctuate intense work with five- or 10-minute breathers will help the "whole person" feel better. This is also part of change training.

Evidently, problems related to heavy and poor usage of computers in the workplace may be reduced with use of ergonomics in the design and implementation of information systems. In fact, in the developed world where many studies have been undertaken, many campaigns are still been carried out to bring the awareness to the

users as seen by the launch of the RSI International Awareness Day in the United States in 2000 (AFL-CIO, 2000). In view of this, attempts are being made to design the workplace (like work tasks, equipment, environment and so on) for safe and efficient use by workers (Hadler, 1993).

2.6 Constraints to ergonomic considerations

Despite the knowledge that the IT consultants could have on ergonomic factors and their desires to have the factors implemented, constraints that may make it difficult to implement the factors are expected. Firstly, there are costs for implementation of ergonomics. Many firms may not afford. Secondly, there is the need for ergonomists, many firms in Kenya cannot justify the costs of training or acquiring an ergonomics expert. Ergonomists are also very limited in number and may be very few, if any in Kenya. Firms have either to invest in the training of one or recruit. Thirdly, constraints to ergonomic factors could emanate from the managers themselves. Many managers in firms have a tendency to look at the current expenditure at the cost of a future expenditure. This way ergonomic considerations would not be given the right attention. Indeed, more often than not, managers "look down" on the impacts, which would most likely emerge in the future forcing

them to incur high expenses in medical bills, compensations and even opportunity costs lost workdays.

Fourthly, many systems in Kenya have been in place for a number of years and may not have considered ergonomics at the design of development stages. The systems are also very inflexible hence not possible to accommodate any changes to include ergonomics.

While managers of firms should look for ways of reducing these constraints and improve ergonomic practice, it is important to determine how firms in Kenya fare in respect of these constraints, hence the purpose of undertaking this study. The methodology considers this.

CHAPTER III

3.0 Research Methodology

3.1 Introduction

This study is sought to explore aspects of ergonomic factors considered in information system implementation and their relative importance. This study also sought to determine constraints to ergonomics considerations. This was done in respect of practice from the point of view of IT consultants, in Nairobi, Kenya. To enrich the study findings, a pilot study was undertaken first.

3.2 Population

The population of the study consisted of all the computer firms categorized in the yellow pages of the 2001 telephone directory as Computers - Hardware and Maintenance, which were 191 in total (Kenya Telephone Directory – 2001). Firms in the yellow pages were expected to be of significance in terms of implementing information systems and ergonomics, since they most likely implemented large information systems with consideration potential of ergonomic problems. The geographical scope of the study was limited to Nairobi, where the highest population of computer firms is based.

A pilot survey covering these firms revealed those firms that truly implemented information systems. Only 77 firms (40.3% of the total population) qualified in that respect. Given the small size of the population a census study was done.

3.3 Data collection

Primary data was collected using questionnaires by a "drop and pick later" approach. To increase the response rate, a follow up was done by use of a research assistant, a telephone call and even by researcher personally visiting the respondents.

A sample questionnaire is shown in Appendix II. It has 4 sections. Section A asked questions that helped tap demographic information for both the firms and the IT consultants, while Section B asked questions that aimed at finding out the IT consultants' rating of the relative importance they placed on a number of ergonomic factors. Section C sought to find out the ergonomic factors that were actually considered for implementation during information systems development. Section D dealt with the constraints or reasons that made it difficult for or hindered the consultants from actually implementing ergonomic factors.

The questionnaire was addressed to IT consultants in IT firms. Each firm was expected to provide one consultant to fill out the questionnaire, after which the questionnaire was collected and coded for data analysis. A letter of introduction (Appendix I) to request for data as well as a questionnaire was handed over to each of the respective heads of the consulting firms who either responded directly or directed the questionnaire to the appropriate respondents in their firms.

3.4 Data analysis and presentation

The data were tabulated and statistically analyzed using averages, percentages and proportions for general findings. These statistics were used to generate frequency tables and proportions or percentages, and graphs. Cross-tabulation was done to determine the level of importance placed on the ergonomic factors by the consultants. This was also done to determine which ergonomic factors were actually considered, and which constraints inhibited the actual consideration of some of the ergonomic factors.

To determine the importance of the factors considered, the ergonomic factors actually considered and the constraints to their actual consideration, mean of scores and other measures of central

tendency were used to rank the responses. Statistical Package for Social Sciences (SPSS) package was used for analysis.

CHAPTER IV

4.0 Data Analysis and Results

4.1 Introduction

This chapter presents the results of the analysis and findings of the study in the form of tables and graphics. These are presented in proportions and percentages. Seventy-seven (77) questionnaires were issued out to the computer firms listed in Appendix III. Out of these, forty-one (41) were successfully completed and returned, representing 53.2% of the respondents. These responses were used as the basis of the data analysis and were considered successful to facilitate the completion of the study. The questionnaires were then edited, and all except the open-ended questions were coded and tabulated for analysis.

The presentation in this chapter begins with demographic information of the IT firms in general followed by that of the specific IT consultants. Each IT firm presented one consultant to fill the questionnaire.

4.2 Demographic characteristics for the firms and IT consultants

The characteristics of the IT firms studied that were considered important for the study included: the year of establishment, the ownership of the firms in terms of local, foreign or jointly owned, the total number of employees, which would influence the consultants appreciation of ergonomics and its impact in Information systems. In addition, individual characteristics that would influence the consultant were age, gender, level of education, working experience in general and with computers and their current work description.

Table 4.2.1 Year of establishment of the firms

Year of Establishment	Number of Firms	Proportion of firms (%)
Before 1950	2	4.9
1951 to 1960	2	4.9
1961 to 1970	3	7.3
1971 to 1980	0	0
1981 to 1990	8	19.5
1991 to 2000	25	61
Missing	1	2.4
Total	**41**	**100**

Table 4.2.1 presents the distribution of the year of establishment for the respondent firms. Most of the firms under the study were established in the period 1991 to 2000. This was followed by those established in the period 1981 to 1990. No firm studied was established in the period 1971 to 1980. Generally most of the firms

studied were established after 1981. Consideration of is important because a firm that has been in operation for a long period of time may be mature enough in its policies to adopt ergonomics out of experience. This may not be necessarily so for a relatively new firm. At the same time, however, a new firm may immediately upon being established adopt policies that insist on ergonomics, based on studies done in developed countries.

Table 4.2.2 Ownership of the firms

Ownership of the firm	Number of firms	Proportion of firms (%)
Locally owned	25	61
Foreign owned	6	14.6
Jointly owned	10	24.4
Total	**41**	**100**

Table 4.2.2 shows the representation of the ownership of the firms. Locally owned firms were 25, and this represents 61% of the firms under study, while foreign owned firms were 6 representing 14.6%. Firms, which had joint ventures representing local and foreign ownership, were 10 representing 24.4% of the firms under study. Most of the firms were either locally or jointly owned. Ownership factor is important as it has implications on the firm's policies and practices, which in turn would impact on the consultants view and appreciation of ergonomics. Also organizational cultures relate to ownership and are able to influence employees in their decision-making and choice of professional adaptation.

Table 4.2.3 Number of employees per firm

Number of employees	Number of Firms	Proportion of Firms (%)
1 to 50	34	83
51 to 100	5	12
101 to 150	1	2.5
151 to 200	0	0.0
Over 200	1	2.5
Total	**41**	**100.00**

The numbers of employees in the respondent firms are presented in Table 4.2.3. Most of the firms had less than 50 employees. They were 34, representing 83% of the firms studied. There were no firms in the category of 151 and 200 employees. Generally most firms had not more than 100 employees.

Tables 4.2.4 to 4.2.10 present pertinent characteristics of the individual respondents. The study aimed at finding the relative importance placed on various ergonomic factors by the individual consultants in these firms. Though company practices in these firms may have had influence on the individual consultant's consideration of ergonomics, it is the individuals themselves who finally actually consider these factors when developing and implementing the information systems, hence the need to consider individual demographic factors.

Table 4.2.4 Respondents' level of education

Level of Education	Number of Responses	Proportion (%)
KCSE	2	4.9
Certificate	4	9.8
IMIS	5	12.2
BSc	23	56.1
MSc	4	9.8
PhD	2	4.9
Missing	1	2.4
Total	**41**	**100**

Table 4.2.4 presents the respondents' level of education. Most of the respondents (23) had a university degree, representing 56.1% of all the respondents. Secondary education and PhD level of education each had (2) or 4.9% of the respondents. The level of education is important in ergonomic consideration. The reason is that it may be representative of the respondents ability to appreciate ergonomics and the decisively consider implementing the factors during information systems development. The representative proportion of 56.1 % for the first degree holders indicates a high likelihood that the ergonomic factors may be considered due to their expected high level of awareness of the need to consider ergonomic factors.

Table 4.2.5 Respondents' work experience in years

Work Experience in Years	Number of Responses	Proportion (%)
1 to 5	15	36.6
6 to 10	17	41.5
11 to 15	5	12.2
16 to 20	2	4.9
21 to 25	2	4.9
Total	**41**	**100**

Table 4.2.5 presents the work experience in years of the respondents. Work experience is essential in that a respondent who has more years of experience is more likely, out of experience to consider ergonomic factors, than one with less. In the study, most respondents had between 6 and 10 years experience. They were 17 representing 41.5% of all the respondents. Those with 16 to 20 and 21 to 25 years experience were 2 each, representing 4.9% each of all the respondents. Most of the respondents had not more than 10 years of work experience.

Table 4.2.6 Respondents' number of years of working with computers

Computer Experience in Years	Number	Proportion (%)
5 yrs or less	14	34.1
6 to 10	15	36.6
11 to 15	5	12.2
16 to 20	3	7.3
20 to 25	1	2.4
Missing	3	7.3
Total	**41**	**100**

Table 4.2.7 Respondents' number of years as IT consultants

Experience as an IT Consultant (Years)	Number	Proportion (%)
5 or less	29	70.7
Missing	12	29.3
Total	**41**	**100**

Table 4.2.6 presents the respondents' working experience with computers, while Table 4.2.7 presents the number of years experience the respondents had had as IT consultants. The two

characteristics may be the same in most cases, but there is a possibility of a respondent, first working on the computers as an end user, before finally attaining the status of IT consultant. A respondent who has experience both, as a user then consultant would be more inclined to consider the implementation of ergonomics. The category 6 to 10 years in Table 4.2.6 had the highest response of 15 respondents representing 36.6% of all the respondents. The lowest was the category 20 to 25 years with 1 respondent. Generally most of the IT consultants had computer work experience of not more than 10 years. As for Table 4.2.7, most of the IT consultants had less than five years experience. The IT consultants with five years of experience were 29 representing 70.7% of all the respondents. Since the survey basically targeted IT consultants, and 5 years experience is considered sufficient in the computer industry to advise on ergonomics, it could be said that most of IT consultants surveyed had enough experience.

Table 4.2.8 Age of respondents

Respondent's Age	Number	Proportion (%)
20 to 25	5	12.2
25 to 30	12	29.3
30 to 35	11	26.8
35 to 40	8	19.5
40 to 45	2	4.9
Missing	3	7.3
Total	**41**	**100**

Table 4.2.8 presents the respondents' age. A respondent's maturity would reflect his ability to consider certain aspects of his profession that would be critical for success of his information system setups. Age in most cases may be a considered an aspect that would reflect this maturity. The category of ages between 25 and 30 had the highest response of 12, representing 29.3%. The category of ages between 40 and 45 had the least responses (2), representing 4.9% of all the respondents. Generally most of the respondents were aged below 35 years.

Table 4.2.9 Work description of the respondents

Work Description	Number	Proportion (%)
System Analyst	12	29.3
Programmer	4	9.8
Instructor	5	12.2
System/Network Engineer	9	22
Sales	6	14.6
Management	3	7.3
Missing	2	4.9
Total	**41**	**100**

Table 4.2.9 presents the work description of the respondents. Systems Analysts were 12, representing 29.3% of all the respondents, Programmers were 4, representing 9.8%, and Computer Instructors were 5, representing 12.2% of all the respondents. There were 9 System/Network Engineers, representing 22% of all the respondents, while 6 of them were Sales Representatives, representing 14.6%. The respondents that were in various capacities in management were 3, representing

7.3% of the respondents. Generally most of the respondents were systems analysts, programmers, instructors and sales persons, and these are expected to play a greater role in ergonomics consideration.

Table 4.2.10 Gender of the respondents

Gender of respondent	Number of responses	Proportion of responses (%)
Male	30	73.2
Female	11	26.8
Total	**41**	**100**

Table 4.2.10 presented the proportions of response in terms of gender. Of all the respondents, 30 were male, representing 73.2% of all the respondents, while 11 of them were female (26.8%). Females generally tend to be more risk averse than males. As to whether this could have implication on ergonomic consideration is a matter of study.

4.3 Relative importance of the ergonomic factors considered by IT consultants.

For IT consultants to have the intention of implementing ergonomics in their design and implementation of information systems, they have to appreciate the ergonomic factors. It is only through their appreciation of these factors that the consultants would probably implement them.

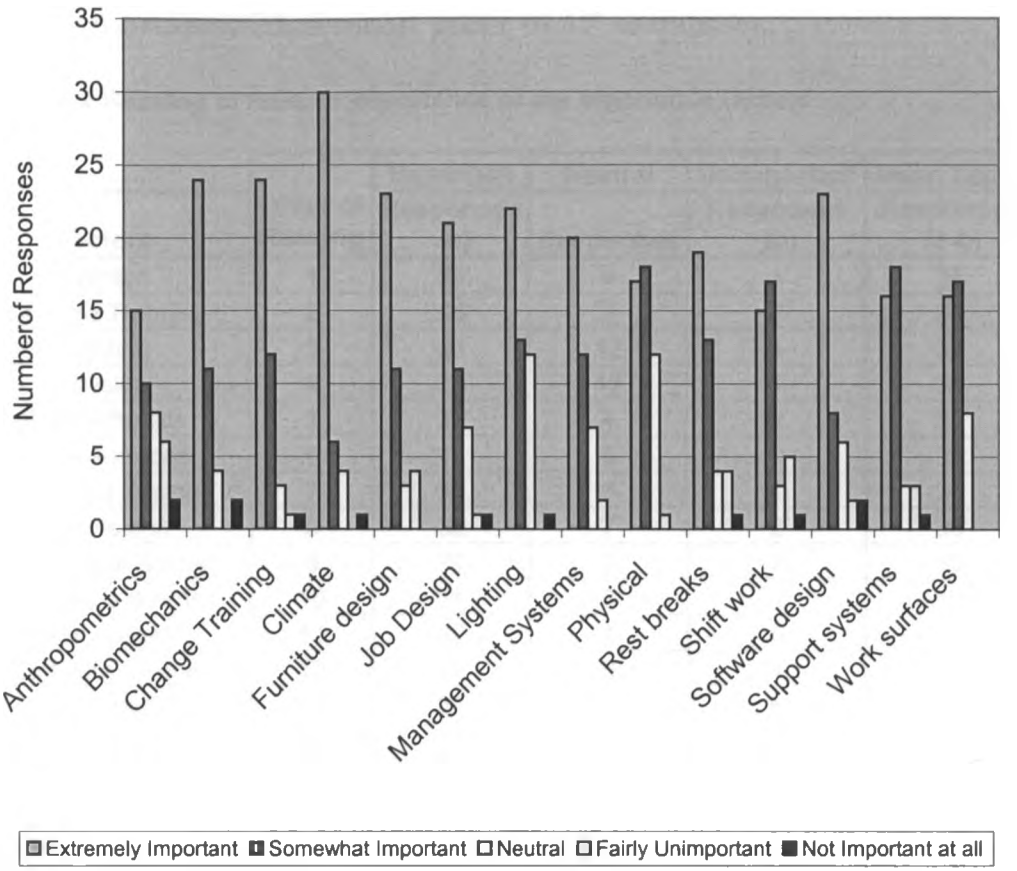
To find out how IT consultants rated the importance of ergonomic factors, data were obtained through Section B of the research instrument. The questionnaire listed fourteen commonly known ergonomic factors and provided for any other that the consultant may have implemented over the years. The level of importance was rated on a 5 scale Likert - scale with the following responses: Extremely important; somewhat important; neither important nor unimportant; fairly unimportant and not important at all. An explanation was provided for each of the factors for ease of understanding. For purposes of tabulation of the data, the neither important nor unimportant response was coded as neutral. The fourteen factors were anthropometrics, biomechanics, climate, change training, furniture design, job design, lighting, management systems, physical, rest breaks, shift work, software design, support systems and work surfaces. The research instrument provided for an extra five entries for any other factor. None of the respondents gave any other factor other than the ones listed above. This may have been that they may have not encountered any other factor and it was likely the list was ideally exhaustive.

Table 4.3.1 Relative importance of the ergonomic factors

	Important		Neutral	Unimportant	
	Extremely	Somewhat		Fairly	Not Important
Factors	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)
Anthropometrics	15 (36.6)	10 (24.4)	8 (19.5)	6 (14.6)	2 (4.9)
Biomechanics	24 (58.5)	11 (26.8)	4 (9.8)	0 (0)	2 (4.9)
Change Training	24 (58.5)	12 (29.3)	3 (7.3)	1 (2.4)	1 (2.4)
Climate	30 (73.2)	6 (14.6)	4 (9.8)	0 (0)	1 (2.4)
Furniture design	23 (56.1)	11 (26.8)	3 (7.3)	4 (9.8)	0 (0)
Job Design	21 (51.2)	11 (26.8)	7 (17.1)	1 (2.4)	1 (2.4)
Lighting	22 (53.7)	13 (31.7)	12 (29.3)	0 (0)	1 (2.4)
Management Systems	20 (48.8)	12 (29.3)	7 (17.1)	2 (4.9)	0 (0)
Physical	17 (41.5)	18 (43.9)	12 (29.3)	1 (2.4)	0 (0)
Rest breaks	19 (46.3)	13 (31.7)	4 (9.8)	4 (9.8)	1 (2.4)
Shift work	15 (36.6)	17 (41.5)	3 (7.3)	5 (12.2)	1 (2.4)
Software design	23 (56.1)	8 (19.5)	6 (14.6)	2 (4.9)	2 (4.9)
Support systems	16 (39.1)	18 (43.9)	3 (7.3)	3 (7.3)	1 (2.4)
Work surfaces	16 (39.1)	17 (41.5)	8 (19.5)	0 (0)	0 (0)

Figure 4.3.1 and Table 4.3.1 show the relative ratings by the respondents of each of the fourteen ergonomic factors. Climate was considered as extremely important by most of the respondents (30), representing 73.2% of all the respondents. This is contrasted by a poll of 15 for anthropometrics and shift work, each representing 36.6% of all the respondents for the same rating. Anthropometrics, biomechanics and software design had 2 responses each for the not important at all rating, which was the highest poll in this rating. No respondents considered furniture design, management systems, the physical factor and work surfaces as not important at all.

Figure 4.3.1 Relative importance of ergonomic factors



Based on the importance placed on the factors, it would then be expected that the factors that would be actually considered during implementation of the information systems by the IT consultants would be climate, biomechanics, change training, software design, job design and management systems in that order, while the factors that would be least expected to be actually considered would be anthropometrics, shift work, support systems and work surfaces in that order. To this end ranking of the factors was done. Table 4.3.2 shows that ranking using mean scores. As can be seen, climate was considered most important with a mean score of 35

responses compared to anthropometrics, which was considered least important with a mean score of 17 responses.

Table 4.3.2 Ranking of relative importance of the ergonomic factors

Factors	Order of Ranking	Important Responses (a)	Neutral Responses	Unimportant Responses (b)	Mean Score Responses (a-b)
Climate	**1**	36	4	1	35
Change Training	**2**	36	3	2	34
Lighting	**3**	35	12	1	34
Physical	**4**	35	12	1	34
Biomechanics	**5**	35	4	2	33
Work surfaces	**6**	33	8	0	33
Furniture design	**7**	34	3	4	30
Job Design	**8**	32	7	2	30
Management Systems	**9**	32	7	2	30
Support systems	**10**	34	3	4	30
Rest breaks	**11**	32	4	5	27
Software design	**12**	31	6	4	27
Shift work	**13**	32	3	6	26
Anthropometrics	**14**	25	8	8	17

It has been indicated in Section 4.2 that a firm's age may have a relation with the rating of the level of importance of ergonomics. Thus it was needful to categorize the year of establishment of the firm with the respective ratings of the ergonomic factors, hence Table 4.3.3a and Table 4.3.3b. These tables present the cross tabulation of the year of establishment of the firms with the importance ratings of the factors. In the tables, anthropometrics, for example had 2 responses or 100%, for the firms established before 1950, considering it as important.

Table 4.3.3a Distribution of year of establishment of firm with importance of ergonomic factors

	Before 1950			1951 to 1960			1961 to 1970		
Factors	**3 (%)**	**2 (%)**	**1 (%)**	**3 (%)**	**2 (%)**	**1 (%)**	**3 (%)**	**2 (%)**	**1 (%)**
Anthropometrics	0 (0)	0 (0)	2 (100)	1 (50)	0 (0)	1 (50)	1 (33.3)	0 (0)	2 (66.7)
Biomechanics	0 (0)	0 (0)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	1 (33.3)	2 (66.7)
Change Training	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Climate	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Furniture Design	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Job Design	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	1 (33.3)	2 (66.7)
Lighting	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Management System	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Physical	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	1 (33.3)	2 (66.7)
Rest Breaks	1 (50)	0 (0)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Shift work	1 (50)	0 (0)	1 (50)	0 (0)	0 (0)	2 (100)	1 (33.3)	0 (0)	2 (66.7)
Software Design	0 (0)	1 (50)	1 (50)	1 (50)	0 (0)	1 (50)	1 (33.3)	1 (33.3)	1 (33.3)
Support Systems	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)
Work Surfaces	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (100)

1= Important, 2=Neutral, 3=Not Important
There was no respondent with year of establishment between 1971 and 1980

Table 4.3.3b Distribution of year of establishment of firm with importance of ergonomic factors

	1981 to 1990			1991 to 2000		
Factors	**3 (%)**	**2 (%)**	**1 (%)**	**3 (%)**	**2 (%)**	**1 (%)**
Anthropometrics	1 (12.5)	2 (25)	5 (62.5)	5 (20)	6 (24)	14 (56)
Biomechanics	2 (25)	1 (12.5)	5 (62.5)	0 (0)	2 (8)	23 (92)
Change Training	1 (12.5)	0 (0)	7 (87.5)	1 (4)	3 (12)	21 (84)
Climate	1 (12.5)	1 (12.5)	6 (75)	0 (0)	2 (8)	23 (92)
Furniture Design	1 (12.5)	0 (0)	7 (87.5)	3 (12)	3 (12)	19 (76)
Job Design	1 (12.5)	2 (25)	5 (62.5)	1 (4)	4 (16)	20 (80)
Lighting	1 (12.5)	2 (25)	5 (62.5)	0 (0)	1 (4)	24 (96)
Management System	2 (25)	1 (12.5)	5 (62.5)	0 (0)	5 (20)	20 (80)
Physical	1 (12.5)	1 (12.5)	6 (75)	0 (0)	2 (8)	23 (92)
Rest Breaks	3 (37.5)	2 (25)	3 (37.5)	1 (4)	2 (8)	22 (88)
Shift work	1 (12.5)	1 (12.5)	6 (75)	2 (8)	2 (8)	21 (84)
Software Design	0 (0)	2 (25)	6 (75)	2 (8)	2 (8)	21 (84)
Support Systems	0 (0)	1 (12.5)	7 (87.5)	3 (12)	2 (8)	20 (80)
Work Surfaces	0 (0)	2 (25)	6 (75)	0 (0)	4 (16)	21 (84)

1= Important, 2=Neutral, 3=Not Important
There was no respondent with year of establishment between 1971 and 1980

Respondents from firms in the period before 1950, numbering 2, had 1 of them (50%), considering lighting for example, as important, the other 1 (50%) as neutral. There was no respondent in this category that considered lighting as not important. The period between 1961 and 1970 had all the 3 respondents in the firms established during that period consider lighting as important. The firms established in the period 1991 to 2000, were 25. Of these, 24 (96%) of them considered lighting as important, while only 1 (4%) considered it as neutral. There were no respondents who considered lighting as not important. This is a period when many people were researching and presenting study reports on ergonomics. So generally, the firms established in the period 1991 to 2000, considered most of the factors as important.

It has been indicated in Section 4.2 that ownership of firm may affect the policy formulation of the firm. Different organizational cultures and policies may affect the way an individual employee performs their duties. Locally owned firms may have different cultures and policies from foreign owned and jointly owned, since the presence of the foreign ownership may impact a lot on the organizational culture. It was shown in Table 4.2.2 that 25 of the respondents worked for locally owned firms, 6 for foreign owned and 10 for jointly owned firms. For ease of reading and

comprehension, the ratings extremely important and somewhat important were considered as important while fairly unimportant and not important at all were considered as not important.

Table 4.3.4 Distribution of firm ownership with importance of factors

	Locally Owned			Foreign Owned			Jointly Owned			Total
Factors	**1 (%)**	**2 (%)**	**3 (%)**	**1 (%)**	**2 (%)**	**3 (%)**	**1 (%)**	**2 (%)**	**3 (%)**	**No. (%)**
Anthropometrics	15 (60)	5(20)	5(20)	3(50)	1(16.7)	2(33.3)	7(70)	2(20)	1(10)	41(100)
Biomechanics	20(80)	3(12)	2(8)	5(83.3)	1(16.7)	0(0)	10(100)	0(0)	0(0)	41(100)
Change Training	21(84)	2(8)	2(8)	6(100)	0(0)	0(0)	9(90)	1(10)	0(0)	41(100)
Climate	21(84)	3(12)	1(4)	5(83.3)	1(16.7)	0(0)	10(100)	0(0)	0(0)	41(100)
Furniture Design	20(80)	2(8)	3(12)	5(83.3)	1(16.7)	0(0)	9(90)	0(0)	1(10)	41(100)
Job Design	17(68)	6(24)	2(8)	5(83.3)	1(16.7)	0(0)	10(100)	0(0)	0(0)	41(100)
Lighting	21(84)	3(12)	1(4)	5(83.3)	1(16.7)	0(0)	9(90)	1(10)	0(0)	41(100)
Management Systems	19(76)	4(16)	2(8)	5(83.3)	1(16.7)	0(0)	8(80)	2(20)	0(0)	41(100)
Physical	20(80)	4(16)	1(4)	5(83.3)	1(16.7)	0(0)	10(100)	0(0)	0(0)	41(100)
Rest Breaks	17(68)	4(16)	4(16)	5(83.3)	0(0)	1(16.7)	10(100)	0(0)	0(0)	41(100)
Shift Work	18(72)	3(12)	4(16)	4(66.7)	0(0)	2(33.3)	10(100)	0(0)	0(0)	41(100)
Software Design	18(72)	4(16)	3(12)	5(83.3)	0(0)	1(16.7)	8(80)	2(20)	0(0)	41(100)
Support Systems	22(88)	1(4)	2(8)	4(66.7)	1(16.7)	1(16.7)	8(80)	1(10)	1(10)	41(100)
Work Surfaces	20(80)	5(20)	0(0)	4(66.7)	2(33.3)	0(0)	9(90)	1(10)	0(0)	41(100)

1= Important, 2=Neutral, 3=Not Important

A cross tabulation of the ownership of the firm with the importance ratings for the fourteen factors in Table 4.3.4 reveals that for anthropometrics, out of the 25 responses from locally owned firms, 15 of them, (60%) considered the factor as important, 5 of them (20%) as neutral, the other 5 of them (20%) considered it as not important. In the foreign owned category, out of the total response of 6, 3 of them, (50%) considered the same factor as important, 1 of them (16.7%) as neutral and the other 2 of them (33.3%) considered it as not important. The firms with joint ownership,

which had a response of 10 firms, had 7 of them, (70%) considering the factor as important, 2 of them (20%) as neutral and 1 of them (10%) considered as not important. The table also reveals that locally owned firms considered the support systems as most important with 22 of them (88%) considering it as important, while anthropometrics was considered least important with only 15 respondents (60%) considering it as important. Foreign owned firms on the other hand, the table reveals, considered change training as most important of the factors with all the 6 (100%) rating it as important. Anthropometrics was considered least important with only 3 of them (50%) rating it as important. Jointly owned firms, considered a number of the factors as most important with all of the 10 (100%) respondents rating biomechanics, climate, job design, physical, rest breaks and shift work as important, while anthropometrics was considered as important by only 7 of them (70%).

Table 4.3.5 and Figure 4.3.2 present how the male and female respondents, rated the importance of the fourteen factors. Read the table for instance as follows, 20 or 66.7% of males considered anthropometrics as important. The respondents were 30 male, representing 73.2% of the respondents, and 11 female, representing 26.8% of the respondents. Of the male respondents

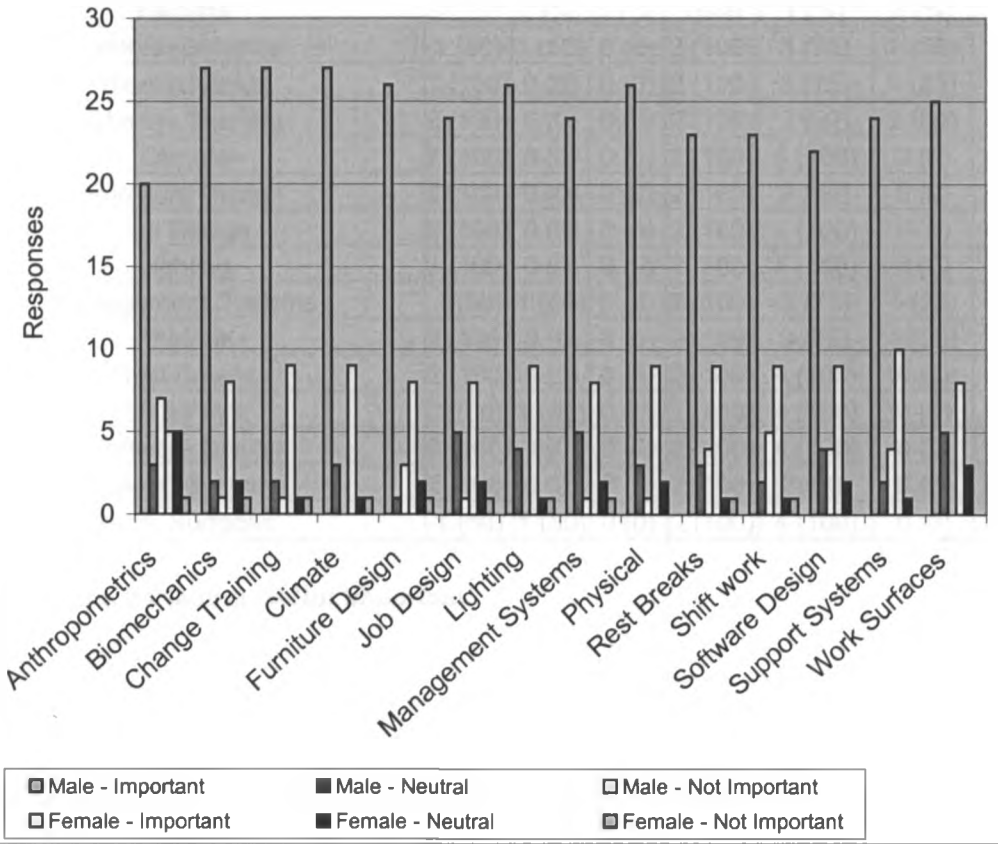
an average of 24 of them rated the factors as important, representing 80% of the male responses, while an average of 8 female respondents, representing 80% of the female responses rated the factors as important. This reveals that females are attracting more importance ergonomics than males, and this seems to agree with the fact that females tend to be risk averse.

Table 4.3.5 Distribution of gender of respondents with importance of factors

	MALE			FEMALE		
Factors	**1 (%)**	**2 (%)**	**3 (%)**	**1 (%)**	**2 (%)**	**3 (%)**
Anthropometrics	20 (66.7)	3 (10)	7 (23.3)	5 (45.5)	5 (45.5)	1(9)
Biomechanics	27 (90)	2 (6.7)	1(3.3)	8 (72.8)	2 (18.2)	1(9)
Change Training	27 (90)	2 (6.7)	1(3.3)	9 (81.8)	1(9)	1(9)
Climate	27 (90)	3 (10)	0 (0)	9 (81.8)	1(9)	1(9)
Furniture Design	26 (86.7)	1(3.3)	3 (10)	8 (72.8)	2 (18.2)	1(9)
Job Design	24 (80)	5 (16.7)	1(3.3)	8 (72.8)	2 (18.2)	1(9)
Lighting	26 (86.7)	4 (13.3)	0 (0)	9 (81.8)	1(9)	1(9)
Management Systems	24 (80)	5 (16.7)	1(3.3)	8 (72.8)	2 (18.2)	1(9)
Physical	26 (86.7)	3 (10)	1(3.3)	9 (81.8)	2 (18.2)	0 (0)
Rest Breaks	23 (56.1)	3 (10)	4 (13.3)	9 (81.8)	1(9)	1(9)
Shift work	23 (56.1)	2 (6.7)	5 (16.7)	9 (81.8)	1(9)	1(9)
Software Design	22 (73.4)	4 (13.3)	4 (13.3)	9 (81.8)	2 (18.2)	0 (0)
Support Systems	24 (80)	2 (6.7)	4 (13.3)	10 (90.9)	1(9)	0 (0)
Work Surfaces	25 (83.3)	5 (16.7)	0 (0)	8 (72.8)	3 (27.3)	0 (0)

1= Important, 2=Neutral, 3=Not Important

Figure 4.3.2 Distribution of gender with factor importance



The respondent's level of education may have some influence in the capacity of the respondent's decision-making process. Thus it was needful to cross tabulate the level of education with the relative rate of importance of the ergonomic factors, hence, Tables 4.3.6a – 4.3.6c. Respondents in this study were requested to state the highest level of education. Responses ranged from O-level to PhD level of education. The level of education of the respondents was cross tabulated with the rating of the relative importance of the parameters.

Table 4.3.6a Distribution of level of education with importance of ergonomic factors

	K.C.S.E.				CERTIFICATE			
Factors	**1 (%)**	**2 (%)**	**3 (%)**	**Total**	**1 (%)**	**2 (%)**	**3 (%)**	**Total**
Anthropometrics	1 (50)	1 (50)	0 (0)	2 (100)	3 (75)	1 (25)	0 (0)	4 (100)
Biomechanics	2 (100)	0 (0)	0 (0)	2 (100)	3 (75)	1 (25)	0 (0)	4 (100)
Change Training	2 (100)	0 (0)	0 (0)	2 (100)	2 (50)	2 (50)	0 (0)	4 (100)
Climate	2 (100)	0 (0)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Furniture Design	2 (100)	0 (0)	0 (0)	2 (100)	2 (50)	0 (0)	2 (50)	4 (100)
Job Design	2 (100)	0 (0)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Lighting	2 (100)	0 (0)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Management Systems	1 (50)	1 (50)	0 (0)	2 (100)	3 (75)	1 (25)	0 (0)	4 (100)
Physical	2 (100)	0 (0)	0 (0)	2 (100)	3 (75)	1 (25)	0 (0)	4 (100)
Rest Breaks	2 (100)	0 (0)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Shift Work	1 (50)	1 (50)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Software Design	2 (100)	0 (0)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)
Support Systems	2 (100)	0 (0)	0 (0)	2 (100)	2 (50)	0 (0)	2 (50)	4 (100)
Work Surfaces	1 (50)	1 (50)	0 (0)	2 (100)	4 (100)	0 (0)	0 (0)	4 (100)

1= Important, 2=Neutral, 3=Not Important

Table 4.3.6b Distribution of level of education with importance of factors

	IMIS				BSc			
Factors	**1 (%)**	**2 (%)**	**3 (%)**	**Total**	**1 (%)**	**2 (%)**	**3 (%)**	**Total**
Anthropometrics	1 (20)	0 (0)	4 (80)	5 (100)	15 (65.2)	6 (26.1)	2 (8.7)	23 (100)
Biomechanics	5 (100)	0 (0)	0 (0)	5 (100)	20 (87)	3 (13)	0 (0)	23 (100)
Change Training	5 (100)	0 (0)	0 (0)	5 (100)	22 (88)	1 (4.3)	0 (0)	23 (100)
Climate	5 (100)	0 (0)	0 (0)	5 (100)	21 (91.3)	2 (8.7)	0 (0)	23 (100)
Furniture Design	4 (80)	1 (20)	0 (0)	5 (100)	21 (91.3)	2 (8.7)	0 (0)	23 (100)
Job Design	3 (60)	2 (40)	0 (0)	5 (100)	19 (83)	4 (17.4)	0 (0)	23 (100)
Lighting	5 (100)	0 (0)	0 (0)	5 (100)	20(87)	3 (13)	0 (0)	23 (100)
Management Systems	4 (80)	1 (20)	0 (0)	5 (100)	19 (83)	4 (17.4)	0 (0)	23 (100)
Physical	5 (100)	0 (0)	0 (0)	5 (100)	19 (83)	3 (13)	1 (4.3)	23 (100)
Rest Breaks	4 (80)	1 (20)	0 (0)	5 (100)	19 (83)	2 (8.7)	2 (8.7)	23 (100)
Shift Work	3 (60)	1 (20)	1 (20)	5 (100)	20 (87)	0 (0)	3 (13)	23 (100)
Software Design	3 (60)	1 (20)	1 (20)	5 (100)	18 (72)	4 (17.4)	1 (4.3)	23 (100)
Support Systems	3 (60)	1 (20)	1 (20)	5 (100)	20 (87)	2 (8.7)	1 (4.3)	23 (100)
Work Surfaces	4 (80)	1 (20)	0 (0)	5 (100)	19 (83)	4 (17.4)	0 (0)	23 (100)

1= Important, 2=Neutral, 3=Not Important

Table 4.3.6c Distribution of level of education with importance of factors

	MSc				PhD			
Factors	**1 (%)**	**2 (%)**	**3 (%)**	**Total**	**1 (%)**	**2 (%)**	**3 (%)**	**Total**
Anthropometrics	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Biomechanics	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Change Training	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Climate	1 (25)	2 (50)	1 (25)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Furniture Design	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Job Design	1 (25)	1 (25)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Lighting	2 (50)	1 (25)	1 (25)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Management Systems	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Physical	3 (75)	1 (25)	0 (0)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Rest Breaks	1 (25)	0 (0)	3 (75)	4 (100)	1 (50)	1 (50)	0 (0)	2 (100)
Shift Work	1 (25)	1 (25)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Software Design	2 (50)	0 (0)	2 (50)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Support Systems	4 (100)	0 (0)	0 (0)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)
Work Surfaces	2 (50)	2 (0)	2 (0)	4 (100)	2 (100)	0 (0)	0 (0)	2 (100)

1= Important, 2=Neutral, 3=Not Important

The cross tabulation of the level of education of the IT consultant with the importance ratings for the fourteen factors, was then presented in Tables 4.3.6a, 4.3.6b and 4.3.6c. It reveals that, for example, anthropometrics, had out of the 2 responses from the consultants with O-Level (KCSE) level of education, 1 of them, (50%) considered the factor as important, 1 of them (50%) as neutral and none of them considered it as not important. In the computer certificate category, out of the total response of 4, 3 of them, (75%) considered the same factor as important, 1 of them (25%) as neutral and none of them considered it as not important. The respondents with the IMIS or Diploma level of education were 5 with 1, (20%) considering the factor as important, 4 of them

(80%) as not important and none of them considered the factor as not important. The table also revealed that those respondents with a first degree level of education were 23 with 15 of them (65.2%) considering anthropometrics as important, 6 of them (26.1%) as neutral and 2 of them considered it as not important. At the same time graduate level respondents, who were 4 in number, had 2 of them (50%) considering anthropometrics as important with the other two considering it as not important. Doctoral level respondents were 2, and both of them (100%) considered anthropometrics as important. PhD level respondents considered most of the factors as important, compared to KCSE level whose rating varied. Generally, most respondents with university education considered the factors as important.

4.4 Ergonomic factors actually considered by IT consultants.

Respondents were asked to indicate the ergonomic factors that they actually considered in the information systems they develop. As shown in Table 4.4.1 and Figure 4.4.1, most of the respondents (39) actually considered lighting in the information systems they implemented. This represented 95% of all the respondents. This was closely followed by climate, which registered 38 responses, representing 92.7% of all the respondents, who actually considered

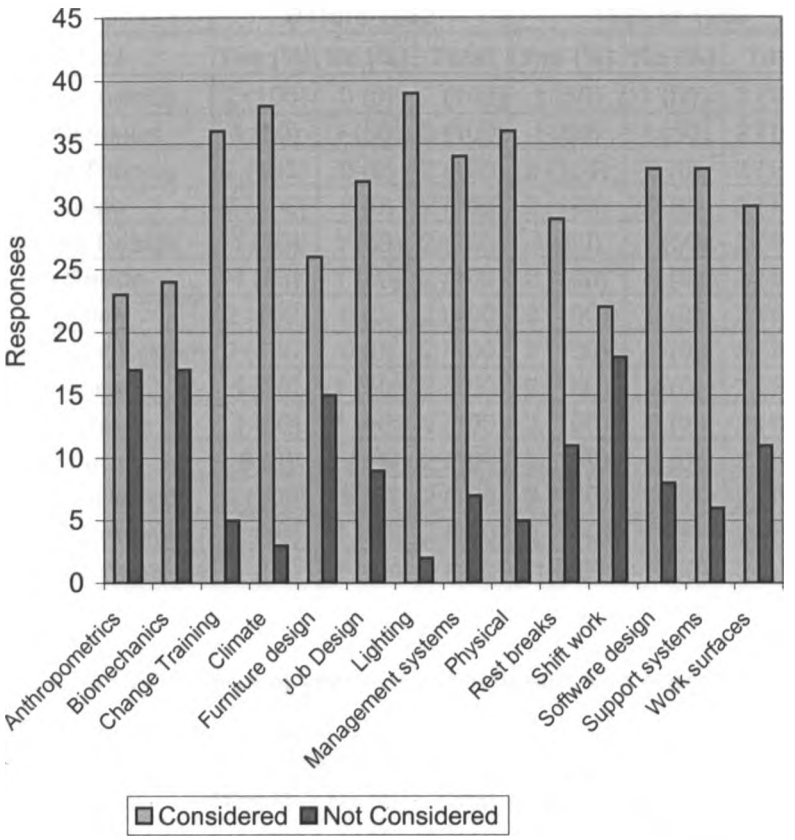
it. Change training and physical factors had 36 respondents each who considered the ergonomic factors. This represented 87.8% of all the respondents.

Table 4.4.1 Ergonomics factors actually considered

	Ratings			
	Yes		No	
Factors	Number	%	Number	%
Anthropometrics	23	57.5	17	42.5
Biomechanics	24	58.5	17	41.5
Change Training	36	87.8	5	12.2
Climate	38	92.7	3	7.3
Furniture design	26	63.4	15	36.6
Job Design	32	78	9	22
Lighting	39	95.1	2	4.9
Management systems	34	82.9	7	17.1
Physical	36	87.8	5	12.2
Rest breaks	29	72.5	11	27.5
Shift work	22	53.7	18	43.9
Software design	33	80.5	8	19.5
Support systems	33	80.5	6	14.6
Work surfaces	30	73.2	11	26.8

Anthropometrics, biomechanics and shift work were the least considered factors with 23, 24 and 22 responses respectively, representing 56.1%, 58.5% and 53.7% respectively. Generally, most of the IT consultants, actually considered the ergonomic factors in the information systems they implemented.

Figure 4.4.1 Ergonomic factors actually considered



It was indicated in Section 4.2 that the age of the firm might have a relation with consideration of ergonomics, hence the need for Tables 4.4.2a and 4.4.2b. Tables 4.4.2a and 4.4.2b present the cross tabulation of the year of establishment of the firms with the consideration of the factors. Respondents from firms in the period before 1950, numbering 2, had 1 of them (50%), actually considering biometrics for example, and the other 1 (50%) has not considering. The period between 1961 and 1970 had all the 3 respondents in the firms established during that period actually considered climate.

Table 4.4.2a Distribution of year of establishment with ergonomic consideration

	Before 1950			1951 to 1960			1961 to 1970		
Factors	**Yes (%)**	**No (%)**	**Total**	**Yes (%)**	**No (%)**	**Total**	**Yes (%)**	**No (%)**	**Total**
Anthropometrics	2 (100)	0 (0)	2 (100)	1 (50)	1 (50)	2 (100)	0 (0)	2 (100)	2 (100)
Biomechanics	1 (50)	1 (50)	2 (100)	1 (50)	1 (50)	2 (100)	1 (33.3)	2 (66.7)	3 (100)
Change Training	2 (100)	0 (0)	2 (100)	2 (100)	0 (0)	2 (100)	3 (100)	0 (0)	3 (100)
Climate	2 (100)	0 (0)	2 (100)	2 (100)	0 (0)	2 (100)	3 (100)	0 (0)	3 (100)
Furniture Design	1 (50)	1 (50)	2 (100)	1 (50)	1 (50)	2 (100)	3 (100)	0 (0)	3 (100)
Job Design	1 (50)	1 (50)	2 (100)	2 (100)	0 (0)	2 (100)	3 (100)	0 (0)	3 (100)
Lighting	2 (100)	0 (0)	2 (100)	2 (100)	0 (0)	2 (100)	2 (66.7)	1 (33.3)	3 (100)
Management System	2 (100)	0 (0)	2 (100)	2 (100)	0 (0)	2 (100)	2 (66.7)	1 (33.3)	3 (100)
Physical	1 (50)	1 (50)	2 (100)	2 (100)	0 (0)	2 (100)	3 (100)	0 (0)	3 (100)
Rest Breaks	1 (50)	1 (50)	2 (100)	2 (100)	0 (0)	2 (100)	2 (66.7)	1 (33.3)	3 (100)
Shift work	0 (0)	2 (100)	2 (100)	2 (100)	0 (0)	2 (100)	0 (0)	3 (100)	3 (100)
Software Design	2 (100)	0 (0)	2 (100)	2 (100)	0 (0)	2 (100)	2 (66.7)	1 (33.3)	3 (100)
Support Systems	1 (50)	1 (50)	2 (100)	2 (100)	0 (0)	2 (100)	2 (66.7)	1 (33.3)	3 (100)
Work Surfaces	1 (50)	1 (50)	2 (100)	1 (50)	1 (50)	2 (100)	3 (100)	0 (0)	3 (100)

Table 4.4.2b Distribution of year of establishment with ergonomic consideration

	1981 to 1990			1991 to 2000		
Factors	**Yes (%)**	**No (%)**	**Total**	**Yes (%)**	**No (%)**	**Total**
Anthropometrics	4 (50)	4 (50)	8 (100)	11 (44)	14 (56)	25 (100)
Biomechanics	6 (75)	2 (25)	8 (100)	14 (56)	11 (44)	25 (100)
Change Training	8 (100)	0 (0)	8 (100)	20 (80)	5 (20)	25 (100)
Climate	7 (87.5)	1 (12.5)	8 (100)	23 (92)	2 (8)	25 (100)
Furniture Design	5 (62.5)	3 (37.5)	8 (100)	15 (60)	10 (70)	25 (100)
Job Design	6 (75)	2 (25)	8 (100)	20 (80)	5 (20)	25 (100)
Lighting	8 (100)	0 (0)	8 (100)	24 (96)	1 (4)	25 (100)
Management System	7 (87.5)	1 (12.5)	8 (100)	20 (80)	5 (20)	25 (100)
Physical	7 (87.5)	1 (12.5)	8 (100)	22 (88)	3 (12)	25 (100)
Rest Breaks	6 (75)	2 (25)	8 (100)	17 (68)	7 (32)	24 (100)
Shift work	5 (62.5)	3 (37.5)	8 (100)	15 (62.5)	9 (37.5)	24 (100)
Software Design	7 (87.5)	1 (12.5)	8 (100)	19 (76)	6 (24)	25 (100)
Support Systems	7 (87.5)	1 (12.5)	8 (100)	20 (87)	3 (13)	23 (100)
Work Surfaces	7 (87.5)	1 (12.5)	8 (100)	17 (68)	8 (32)	25 (100)

The firms established in the period 1991 to 2000, were 25. Of these, 24 (96%) of them actually considered lighting, while only 1 (4%) of them did not consider. It is important to note that this is a

period when many people were researching and presenting study reports on ergonomics.

Different organizational cultures and policies may affect the way an individual employee performs his/her duties, as already indicated in Section 4.2. Locally owned firms may have different cultures and policies from foreign owned and jointly owned, since the presence of the foreign ownership may impact a lot on the organizational culture. In Table 4.1.2 it was seen that 25 of the respondents worked for locally owned firms, 6 for foreign owned and 10 for jointly owned firms. For ease of reading and comprehension, the ratings extremely important and somewhat important were considered as important while fairly unimportant and not important at all were considered as not important.

A cross tabulation of the ownership of the firm with the consideration of the fourteen factors resulting in Table 4.4.3 and Figure 4.4.2, shows that for anthropometrics, out of the 25 responses from locally owned firms, 9 of them, (37.5%) did not actually consider, while in the foreign owned category, out of the total response of 6, 4 of them, (66.7%) did not actually consider the factor. The firms with joint ownership, which had a response of 10 firms, had 6 of them, (60%) actually considering the factor. The table also shows that locally owned firms actually considered the

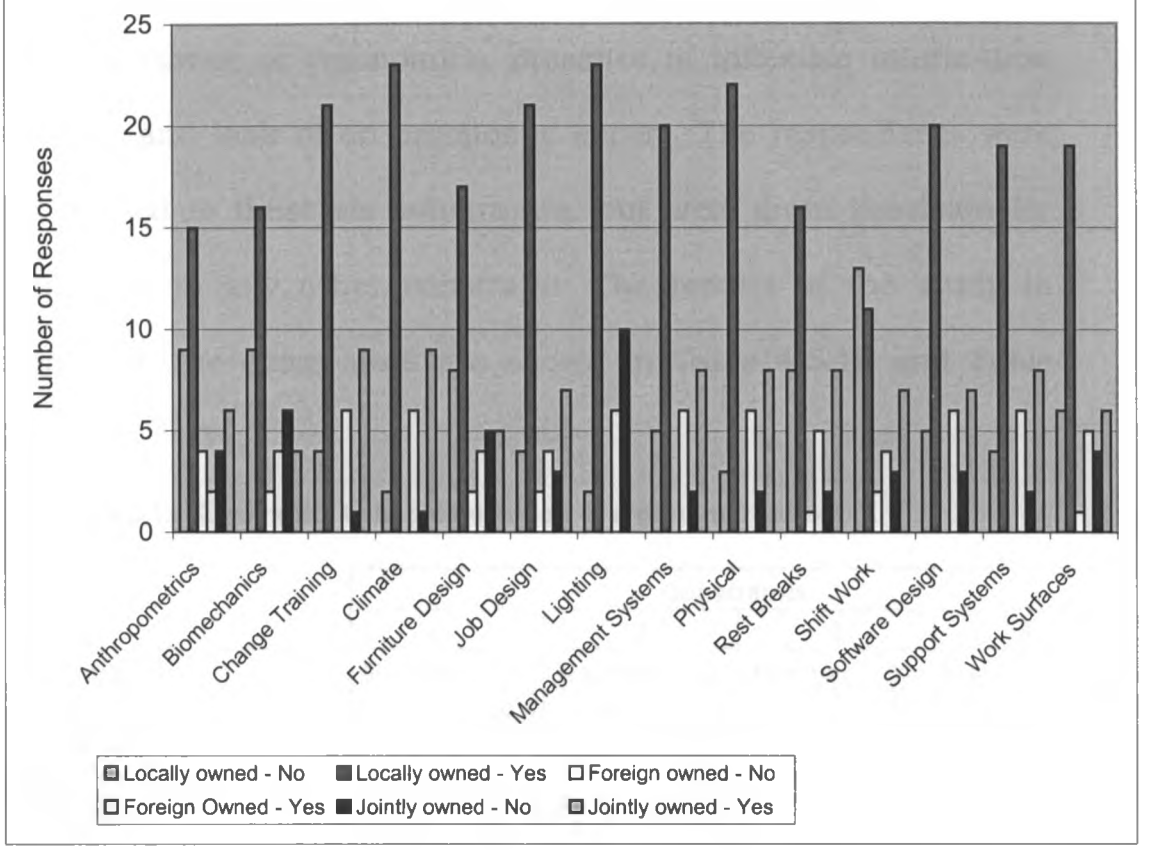
lighting and climate factors most (92%), while shift work was least considered with only 11 respondents (46.9%) actually considering.

Table 4.4.3 Distribution of ownership of firms with consideration of ergonomic factors.

	Locally Owned			Foreign Owned			Jointly Owned		
Factors	**No (%)**	**Yes (%)**	**Total (%)**	**No (%)**	**Yes (%)**	**Total (%)**	**No (%)**	**Yes (%)**	**Total (%)**
Anthropometrics	9 (37.5)	15 (62.5)	24 (100)	4 (66.7)	2 (33.3)	6 (100)	4 (40)	6 (60)	10 (100)
Biomechanics	9 (36)	16 (64)	25 (100)	2 (33.3)	4 (66.7)	6 (100)	6 (60)	4 (40)	10 (100)
Change Training	4 (16)	21 (84)	25 (100)	0 (0)	6 (100)	6 (100)	1 (10)	9 (90)	10 (100)
Climate	2 (8)	23 (92)	25 (100)	0 (0)	6 (100)	6 (100)	1 (10)	9 (90)	10 (100)
Furniture Design	8 (32)	17 (68)	25 (100)	2 (33.3)	4 (66.7)	6 (100)	5 (50)	5 (50)	10 (100)
Job Design	4 (16)	21 (84)	25 (100)	2 (33.3)	4 (66.7)	6 (100)	3 (30)	7 (70)	10 (100)
Lighting	2 (8)	23 (92)	25 (100)	0 (0)	6 (100)	6 (100)	0 (0)	10 (100)	10 (100)
Management Systems	5 (20)	20 (80)	25 (100)	0 (0)	6 (100)	6 (100)	2 (20)	8 (80)	10 (100)
Physical	3 (12)	22 (88)	25 (100)	0 (0)	6 (100)	6 (100)	2 (20)	8 (80)	10 (100)
Rest Breaks	8 (33.3)	16 (66.7)	24 (100)	1 (16.7)	5 (83.3)	6 (100)	2 (20)	8 (80)	10 (100)
Shift Work	13 (54.1)	11 (46.9)	24 (100)	2 (33.3)	4 (66.7)	6 (100)	3 (30)	7 (70)	10 (100)
Software Design	5 (20)	20 (80)	25 (100)	0 (0)	6 (100)	6 (100)	3 (30)	7 (70)	10 (100)
Support Systems	4 (17.4)	19 (82.6)	23 (100)	0 (0)	6 (100)	6 (100)	2 (20)	8 (80)	10 (100)
Work Surfaces	6 (24)	19 (76)	25 (100)	1 (16.7)	5 (83.3)	6 (100)	4 (40)	6 (60)	10 (100)

Foreign owned firms on the other hand the table reveals, actually considered most of the factors, while anthropometrics was least considered with only 2 of them (33.3%) actually considering it. Jointly owned firms, actually considered lighting with all of the 10 (100%) respondents considering it, while biomechanics was least considered with only 4 of them (40%), considering it. So generally, foreign owned firms actually considered the ergonomic factors more that the locally and jointly owned firms. Locally owned firms had the least consideration of the ergonomic factors.

Figure 4.4.2 Distribution of firm ownership with factors considered



4.5 Constraints to consideration of ergonomic factors

Despite the importance to which IT consultants attach to ergonomic factors, constraints are expected to inhibit the actual implementation of the ergonomic factors. To this end, the study also aimed at finding out which constraints or reasons hindered the consideration of ergonomic factors. The common constraints that may have contributed to the failure to consider ergonomic factors were listed as development, resource and implementation

costs; ignorance of the factor by the user of the system; users' "play down" of the impact of the factors; the user not convinced of the importance of ergonomics; presence of inflexible information systems and lack of an ergonomic expert. The respondents were not limited to these six constraints, but were given provision for responses to any other constraint. The results of the study in respect of the constraints are shown in Table 4.5.1a and Table 4.5.1b.

Table 4.5.1a Constraints to implementation of ergonomic factors

	Constraints							
	1		2		3		4	
Factors	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Anthropometrics	6	14.6	10	24.4	8	19.5	7	17.1
Biomechanics	9	22	12	29.3	10	24.4	3	7.3
Change training	23	56.1	6	14.6	5	12.2	1	2.4
Climate	21	51.2	4	9.8	7	17.1	6	14.6
Furniture Design	14	34.1	7	17.1	8	19.5	5	12.2
Job Design	6	14.6	8	19.5	7	17.1	4	9.8
Lighting	12	29.3	11	26.8	11	26.8	1	2.4
Management Systems	10	24.4	7	17.1	10	24.4	9	22
Physical	21	51.2	3	7.3	5	12.2	5	12.2
Rest Breaks	6	14.6	7	17.1	12	29.3	5	12.2
Shift Work	10	24.4	5	12.2	13	31.7	3	7.3
Software Design	3	7.3	12	29.3	8	19.5	5	12.2
Support Systems	21	51.2	7	17.1	3	7.3	5	12.2
Work Surface	11	26.8	7	17.1	13	31.7	5	12.2

1 = Development, resource and implementation costs
2 = Ignorance of the factor by User
3 = "Play down" on the impact of the factors
4 = User not convinced of the importance of Ergonomics
5 = Presence of Inflexible Information Systems
6 = Lack of an ergonomic resource or expert

Table 4.5.1b Constraints to implementation of ergonomics factors

	Constraints					
	5		6		Total	
Factors	Number	%	Number	%	Number	%
Anthropometrics	9	22	1	2.4	41	100
Biomechanics	1	2.4	6	14.6	41	100
Change training	1	2.4	4	9.8	41	100
Climate	1	2.4	2	4.9	41	100
Furniture Design	1	2.4	6	14.6	41	100
Job Design	6	14.6	9	22	41	100
Lighting	5	12.2	1	2.4	41	100
Management Systems	1	2.4	3	7.3	41	100
Physical	1	2.4	5	12.2	41	100
Rest Breaks	5	12.2	2	4.9	41	100
Shift Work	6	14.6	4	9.7	41	100
Software Design	9	22	3	7.3	41	100
Support Systems	3	7.3	1	2.4	41	100
Work Surface	1	2.4	1	2.4	41	100

Each of the factors attracted different responses on the constraints from the respondents. As given in Table 4.5.1a and Table 4.5.1b, change training, climate, physical and support systems were mostly constrained by the development, resource and implementation costs, with 23 responses (56.1%), for change training and 21(51.2%), for the other three factors. Another constraint that featured most in the responses was "ignorance of the factor by the user". Anthropometrics reported 10 responses (24.4%), biomechanics reported 12 responses (29.3%), job design reported 8 responses (19.5%), lighting, 11 responses (26.8%), software design 12 responses (29.3%), support systems 7 responses (17.1%) and work surfaces 7 responses (17.1%). User

"play down" on the impact of the factors had a relatively high response too, with biomechanics reported 10 responses (24.4%), climate, 7 responses (17.1%), furniture design 8 responses (19.5%), lighting 11 responses (26.8%), management systems 10 responses (24.4%), rest breaks 12 responses (29.3%) and shift work and work surface each of them having 13 responses (31.7%). Presence of inflexible information systems proved as a constraint only anthropometrics 9, (22%), job design 6 responses (14.6%), shift work 6 responses (14.6%) and software design 9 responses (22%). Generally, constraints varied from ergonomic factor to ergonomic factor with "development, resource and implementation costs" being the most prevalent constraint, and with change training being the factor reported as being laden with most constraints among the respondents.

CHAPTER V

5.0 Summary, Conclusions, Limitation and Suggestions for Further Research

5.1 Summary

The current trends in IT have seen increase in computer usage at both corporate and domestic levels. This trend is expected to continue as many firms use computerized information technology to compete in the dynamic and complex business environment. Computer users will continue interfacing more and more with computers especially with the advent of new technologies like the Internet, intranet and extranets. It is this increased computer usage if unchecked could be harmful to the users. In view of this, firms and government organizations have to adopt preventive measures, as curative ones would be very expensive, to reduce any incidences of computer usage and work related illness.

The present study focused, as objectives, on ergonomics in computer-based information systems with the view to determining their relative importance, actual state of their consideration and the factors that constraint their consideration. This was from the point of view of IT consultants in Nairobi, Kenya and their firms.

In order to achieve the objective of this study, data were collected using questionnaires from 41 IT consultants.

Analysis of the data revealed the following:

a. A most of the respondents considered ergonomic factors as important with 75% of locally owned IT firms', 85% of foreign owned firms' and 90% of jointly owned firms' consultants rating the factors as important. This was a good overall indicator for the ratings of importance for the factors.

b. The rating of importance of the ergonomic factors varied with the level of education. An average of 75% of the consultants with KCSE level of education considered the factors as important while the PhD level consultants had a 100% rating.

c. The factors that were actually implemented or rather considered mostly by consultants were climate (73.2%), and change training and biomechanics (58.5%). Anthropometrics was considered as least important (57.5%).

d. Results also showed that several factors considered important could not be implemented. The main constraint recorded in the implementation of these factors was the

development, resource and implementation costs. Change training for example, showed a high response of 56%.

e. The factors that were greatly affected by constraints were shift work (53.7%) and biomechanics (58.5%), though initially considered important.

5.2 Conclusions

The findings of the study indicate that:

a. Ergonomic factors are considered as important mostly by IT consultants, in firms established after 1980, in foreign owned firms and who are female

b. Generally ergonomics are actually implemented with certain constraints, and

c. Constraints that inhibit actual implementation of ergonomic factors, include, development, resource and implementation cost, presence of inflexible systems, lack or ergonomic resource and so on.

5.3 Limitations

1. There were no serious limitations in this study other than that of no response from some of the firms, which could have given a better representation and thus better result.

2. There was a shortage of time and so only the questionnaires that were ready and collected in good time were used for data analysis. Thorough work on the research design, including data collection and documentation could have been done resulting in richer findings, had there been more time to undertake the study in depth and perform stronger statistical tests.
3. There was not enough background information on ergonomics to lay a good foundation fro the study.

5.4 Suggestions for further research

Issues that came to light in this study suggest that the research could be extended to study on:

a. The nature of ergonomics being implemented in the computerization
b. Relationship between demographic factors of consultants and their firms.
c. The actual effect of demographic factors on account of ergonomic factors consideration.
d. The extent of the impacts on the actual consideration or failure to consider ergonomics.

APPENDIX I

Letter of introduction to the respondents.

Anthony M. Wachira,
University of Nairobi,
Faculty of Commerce,
P. O. Box 30197,
NAIROBI.

Dear Sir/Madam,

I am a student in the Faculty of Commerce of University of Nairobi. In partial fulfillment of the requirements of the Master of Business Administration (MBA), I am conducting a study entitled **ERGONOMIC FACTORS CONSIDERED IN INFORMATION SYSTEMS IMPLEMENTED IN KENYA – THE CASE OF INFORMATION SYSTEMS FIRMS IN NAIROBI.**

Your firm has been selected to form part of this study. To this end I kindly request for your assistance in completing this questionnaire. Any additional information you might feel necessary for this study is welcome.

The information and data required is needed for academic purposes only and will be treated in strict confidence.

Your cooperation will be highly appreciated.
Thank you.

Yours sincerely,

Anthony M. Wachira
MBA Student

Joel K. Lelei
Supervisor

APPENDIX II

Questionnaire

Please answer the following questions by ticking where applicable or filling in the blanks.

SECTION A

1. State the year of establishment of your firm _____
2. What is the ownership of your firm?
   - Local ☐
   - Foreign ☐
   - Both ☐
3. How many employees are there in the Kenyan establishment of your firm? _____
4. What is your level of education? (e.g. PhD, Bed, IMIS, KCSE etc)
   _____
5. State your working experience in years _____
6. For how long (in years) have you been consistently working with computers? _____
7. For how long have you worked as an IT consultant? _____
8. What is your age? _____
9. How would you describe your work?
   - Systems Analyst ☐
   - Programmer ☐
   - Others (Please Specify) _____
10. State your gender
    - Male ☐
    - Female ☐

SECTION B

Rate the level of importance to which you attach to the following workplace ergonomic factors using the following Likert-scale.

5. Extremely important
4 Somewhat important
3. Neither important nor unimportant
2. Fairly unimportant
1. Not important at all

11. The fitting of human body measurements within the design and implementation of information systems. **(Anthropometrics)**

1 2 3 4 5
☐ ☐ ☐ ☐ ☐

12. Mechanical behaviour of musculoskeletal tissues like hand muscles, when performing physical work. **(Biomechanics)**

1 2 3 4 5
☐ ☐ ☐ ☐ ☐

13. Sensitization and training on the expectations during and after change. **(Change Training)**

1 2 3 4 5
☐ ☐ ☐ ☐ ☐

14. Heating, Ventilation and Air Conditioning of the work area. **(Climate)**

1 2 3 4 5
☐ ☐ ☐ ☐ ☐

15. Ergonomic design of the chairs, tables etc for the work place. **(Furniture Design)**

1	2	3	4	5
☐	☐	☐	☐	☐

16. Job designs and specifications to accommodate health and psychological status of the users. **(Job Designs)**

1	2	3	4	5
☐	☐	☐	☐	☐

17. Provision of sufficient lighting in the room and antiglare facilities. **(Lighting)**

1	2	3	4	5
☐	☐	☐	☐	☐

18. Use of office partitions, privacy filters like antiglare filters, for computer screens, password, etc to enhance privacy on the computers. **(Management Systems)**

1	2	3	4	5
☐	☐	☐	☐	☐

19. Ensure sufficient availability and type of space to comfortably accommodate all users expected to be working in the area. **(Physical)**

1	2	3	4	5
☐	☐	☐	☐	☐

20. Design of work schedule to allow for breaks between work sessions and to reduce strain due long continuous periods of being in the same posture. **(Rest Breaks)**

1	2	3	4	5
☐	☐	☐	☐	☐

21. Use of scheduled shifts in work to provide for job continuity and avoid long repetitive activities. **(Shift work)**

1	2	3	4	5
☐	☐	☐	☐	☐

22. Use of Macros and function keys for repetitive keystroke activities and graphical screen designs appealing to the eye. **(Software Design)**

1	2	3	4	5
☐	☐	☐	☐	☐

23. Availability and placement of support systems like printers, fax machines, coffee/tea dispensers etc within the works area. **(Support Systems)**

1	2	3	4	5
☐	☐	☐	☐	☐

24. Placement of working implements like pens, erasers, phones, mouse, etc within comfortable reach by user when required. **(Work Surfaces)**

1	2	3	4	5
☐	☐	☐	☐	☐

25. Others factors, please specify and respond appropriately.

	1	2	3	4	5
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐

SECTION C

Do you ***consider*** the following ergonomic factors when developing and/or implementing Information systems?

26. The fitting of human body measurements within the design and implementation of information systems. **(Anthropometrics)**

Yes	**No**
☐	☐

27. The mechanical behaviour of musculoskeletal tissues like hand muscles, when performing physical work. **(Biomechanics)**

Yes	**No**
☐	☐

28. Sensitization and training on the expectations during and after change. **(Change Training)**

Yes	**No**
☐	☐

29. Heating, Ventilation and Air Conditioning of the work area. **(Climate)**

Yes	**No**
☐	☐

30. Ergonomic design of the chairs, tables etc for the work place. **(Furniture Design)**

Yes	**No**
☐	☐

31. Job designs and specifications to accommodate health and psychological status of the users. **(Job Designs)**

Yes	**No**
☐	☐

32. Provision of sufficient lighting in the room and antiglare facilities. **(Lighting)**

Yes **No**

☐ ☐

33. Use of office partitions, privacy filters like antiglare filters, for computer screens, password, etc to enhance privacy on the computers. **(Management Systems)**

Yes **No**

☐ ☐

34. Ensure sufficient availability and type of space to comfortably accommodate all users expected to be working in the area. **(Physical)**

Yes **No**

☐ ☐

35. Design of work schedule to allow for breaks between work sessions and to reduce strain due long continuous periods of being in the same posture. **(Rest Breaks)**

Yes **No**

☐ ☐

36. Use of scheduled shifts in work to provide for job continuity and avoid long repetitive activities. **(Shift work)**

Yes **No**

☐ ☐

37. Use of Macros and function keys for repetitive keystroke activities and graphical screen designs appealing to the eye. **(Software Design)**

Yes **No**

☐ ☐

38. Availability and placement of support systems like printers, fax machines, coffee/tea dispensers etc within the works area. **(Support Systems)**

Yes	**No**
☐	☐

39. Placement of working implements like pens, erasers, phones, mouse, etc within comfortable reach by user when required. **(Work surfaces)**

Yes	**No**
☐	☐

40. Others factors, please specify and respond appropriately.

	Yes	**No**
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐
_____	☐	☐

SECTION D

For each of the following ergonomic factors, indicate, using the responses below, the constraints you encounter that make the factors not to be considered in the development and implementation of Information systems.

1. ***Development, resource and implementation costs.***
2. ***Ignorance of the factor by the user.***
3. ***"Play down" on the impact of the factors.***
4. ***User not convinced of the importance of ergonomics.***
5. ***Presence of inflexible information systems.***
6. ***Lack of an ergonomic resource or expert.***
7. ***Others please specify.***

41. The fitting of human body measurements within the design and implementation of information systems. **(Anthropometrics)**

1	*2*	*3*	*4*	*5*	*6*	*7*
☐	☐	☐	☐	☐	☐	_____
						_____
						_____
						_____
						_____

42. The mechanical behaviour of musculoskeletal tissues like hand muscles, when performing physical work. **(Biomechanics)**

1	*2*	*3*	*4*	*5*	*6*	*7*
☐	☐	☐	☐	☐	☐	_____
						_____
						_____
						_____
						_____

43. Sensitization and training on the expectations during and after change. **(Change Training)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

44. Heating, Ventilation and Air Conditioning of the work area. **(Climate)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

45. Ergonomic design of the chairs, tables etc for the work place. **(Furniture Design)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

46. Job designs and specifications to accommodate health and psychological status of the users. **(Job Designs)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

47. Provision of sufficient lighting in the room and antiglare facilities. **(Lighting)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____
_____
_____
_____
_____

48. Use of office partitions, privacy filters like antiglare filters, for computer screens, password, etc to enhance privacy on the computers. **(Management Systems)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____
_____
_____
_____
_____

49. Ensure sufficient availability and type of space to comfortably accommodate all users expected to be working in the area. **(Physical)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____
_____
_____
_____
_____

50. Design of work schedule to allow for breaks between work sessions and to reduce strain due long continuous periods of being in the same posture. **(Rest Breaks)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

51. Use of scheduled shifts in work to provide for job continuity and avoid long repetitive activities. **(Shift work)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

52. Use of Macros and function keys for repetitive keystroke activities and graphical screen designs appealing to the eye. **(Software Design)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

53. Availability and placement of support systems like printers, fax machines, coffee/tea dispensers etc within the works area. **(Support Systems)**

1 *2* *3* *4* *5* *6* *7*

☐ ☐ ☐ ☐ ☐ ☐ _____

_____

_____

_____

_____

54. Placement of working implements like pens, erasers, phones, mouse, etc within comfortable reach by user when required. **(Work surfaces)**

1	*2*	*3*	*4*	*5*	*6*	*7*
☐	☐	☐	☐	☐	☐	_____
						_____
						_____
						_____
						_____

55. Others factors, please specify the constraints and respond appropriately.

1	*2*	*3*	*4*	*5*	*6*	*7*
☐	☐	☐	☐	☐	☐	_____
☐	☐	☐	☐	☐	☐	_____
☐	☐	☐	☐	☐	☐	_____
☐	☐	☐	☐	☐	☐	_____
☐	☐	☐	☐	☐	☐	_____

Thank you for your response and participation in this survey.

APPENDIX III

List of IT firms surveyed

1. Africaland Computers Kenya Ltd
2. Aftron Computer Systems
3. Amarco (Kenya) Ltd
4. Ascent Technologies &Business Ltd
5. Automated Business Systems
6. Blue Chip Technologies Ltd
7. Blue Chip 2000 Systems Ltd
8. Bytech Engineering Ltd
9. Compaq East Africa Representative Office
10. Comp-Rite Kenya Ltd
11. Compucare
12. Compulynx Ltd
13. Compustat Technologies
14. Computech Ltd
15. Computer City
16. Computer Point (K) Ltd
17. Computer Technics Ltd
18. Computron Systems (K) Ltd
19. Comtech Systems Ltd
20. Copy Cat Ltd
21. Dee Dee Computers Plus
22. Digital Africa Services Ltd
23. First Computers Ltd
24. Future Logic Ltd
25. ICL Kenya Ltd
26. ICN – Toshiba Ltd
27. Infortech Computer Systems Ltd
28. Insight Technologies Ltd
29. Kenafro Computers Ltd
30. Kenya Microcomputers Ltd
31. Kingsway Business Systems Ltd
32. Legend Technologies (EPZ) Ltd
33. Limpo Business Systems Ltd
34. Matrix Group
35. Metropolitan Technologies Ltd
36. Micro Kenya Ltd
37. Microflex Kenya Ltd
38. Microlan Kenya Ltd
39. Millenium Automation Ltd
40. Mitsumi Computer Garage Ltd
41. M-M Computers

42. Modern Business Communications Ltd
43. Multi Options Ltd
44. NCR (Kenya) Ltd
45. Next Technology
46. OEL Sysnet Ltd
47. Personal Computer World Ltd
48. PCTech Systems Ltd
49. Pentium Technologies
50. Peripherals Technologies Ltd
51. Personal Computer World Ltd
52. Personal Systems Ltd
53. Pinnacle Relational Database Systems
54. Premier Soft Ware Ltd
55. Prodata Computers Ltd
56. Professional Computer Consultants Ltd
57. Protec Data Systems Ltd
58. Sai Informatics Ltd
59. Sai Office Supplies Ltd
60. Silicon Communication Solutions
61. Simple Computers
62. Startup Suppliers Ltd
63. Surfnet Communication Systems
64. Software Applications Ltd
65. Symphony
66. Telerosa Computer Services Ltd
67. Trans Business Machines Ltd (TBM)
68. Ticentric Computers
69. Tronic world Ltd
70. Unitek Computer Services Ltd
71. Violet Computers Ltd
72. Virtual Computers Ltd
73. Vision Technologies
74. Voice & Data Systems
75. Web Engineering Limited
76. Winksoft Technologies
77. Zodiac Systems Ltd

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