

CULTURAL FACTORS AND IMPLEMENTATION OF ERGONOMICS IN DEVELOPING COUNTRIES

(AN INDUSTRIAL PSYCHOLOGICAL STUDY OF SELECTED CULTURAL
FACTORS WITH SPECIFIC REFERENCE TO THE TRANSFER OF
TECHNOLOGY WITHIN THE EASTERN MPUMALANGA PROVINCE, ONE
OF NINE PROVINCES OF SOUTH AFRICA)

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DECLARATION

I, the undersigned, hereby declare that the work contained in this assignment is my own original word and that I have not previously in its entirety or in part submitted it at any university for a degree.

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Date:

ABSTRACT

When considering the attitude of a workforce towards their work and ways of increasing their motivation, attention must be given to their culture. Attitudes within an organization are due to the attitudes that exist in the culture from which the members of the organization have come. Management practices, therefore, must cope with the attitudes and prejudices of the cultures within the organization. These cultures have been influenced by many factors like religious doctrine and history, not primarily concerned with the efficiency and productivity of the organization.

Ergonomics aim at the optimization of the interaction between human and machine and the operating environment. This can provide the information necessary to promote an acceptable and efficient interaction between human-machine and environment in any form of a human-at-work system.

In the process of technology transfer from Industrial Developed Countries to Industrial Developing Countries, emphasis is laid on economic progress. Although improvement of the economic situation and the standard of living is important to achieve, neglecting ergonomic considerations is both economically expensive and socially disturbing, thus creating negative effects in the country acquiring the technology.

Ergonomics serve as a link between human factor considerations and the transfer of technology. A comprehensive systems model of Ergonomics was used, which indicates the interaction between facets emphasizing information as a core dynamic process, which can be useful to ensure optimality of choices of technology.

In this study the influence of culture on the implementation of ergonomics was studied with specific reference to the transfer of technology in developing countries. Cultural diversity factors such as language/communication, religious beliefs, anthropometrics, educational background time, ethnicity values, attitude and values was measured using a specially designed questionnaire. It was completed by eighteen managers representing seven large industries in the Mpumalanga province.

The cultural factor with the highest significance was 'time'. Others with high significance were educational background, attitude, language/communication and values. Ethnicity values, anthropometrics and religious beliefs were cultural factors which was not considered to be significant, however the population was very small and it is considered that they do contribute towards the implementation of ergonomics.

Training, imported technology and management are external factors, which make a useful and practical contribution to the subject of Ergonomics and the implementation thereof in organizations. If understood, cultural factors provide a much richer environment and different viewpoints, which can increase productivity by the effective use of technology.

OPSOMMING

Wanneer 'n werkerskorps ondersoek word met betrekking tot hul houdings teenoor werk en wyses om hul motivering te verhoog, moet aandag geskenk word aan hul kultuur. Houdings binne 'n organisasie ontstaan uit houdings wat reeds bestaan in die kultuur waaruit lede van die organisasie oorspronklik kom. Bestuurspraktyke moet die houdinge en bevooroordeelings van kulture binne die organisasie hanteer. Hierdie kulture is beïnvloed deur vele faktore soos geloofsdoktrines en geskiedenis wat nie primêr gerig is op die effektiwiteit en produktiwiteit van die organisasie nie.

Ergonomika het ten doel die optimisering van die interaksie tussen mens en masjien en die omgewing van funksionering, wat die nodige inligting kan voorsien wat nodig is om aanvaarbare en effektiewe interaksie te bewerkstellig tussen mens, masjien en die omgewing ten opsigte van enige mens-by-sy-werk sisteem.

In die proses van tegnologiese oordrag vanaf Industriële Ontwikkelde Lande na Industriële Ontwikkelende Lande, word klem gelê op ekonomiese vooruitgang. Alhoewel verbetering van die ekonomiese situasie en 'n verhoging van die standaard van lewe belangrik is om te bereik, sal die verwaardloosing van ergonomiese oorwegings beide ekonomies duur en sosiaal verontrustend wees en gevolglik negatiewe effekte veroorsaak binne die land wat die tegnologie moet verkry.

Ergonomika dien as 'n skakel tussen die menslike faktor oorwegings en die oordrag van tegnologie. 'n Omvattende sisteem model van Ergonomika dui op die interaksie tussen belangrike fasette van inligting as 'n dinamiese kern proses wat bruikbaar kan wees by die optimisering van keuses van tegnologie.

In hierdie studie word die invloed van kulturele faktore op die implementering van ergonomika bestudeer met spesifieke verwysing na die oordrag van tegnologie. Kulturele diversiteitsfaktore soos taal/kommunikasie, gelowe, antropometrie, opvoedkundige agtergrond, tyd, etniese waardes, houding en waardes is gemeet deur 'n spesiaal ontwerpte vraelys. Dit is voltooi deur agtien bestuurders wat sewe groot industrieë in die Mpumalanga provinsie verteenwoordig.

Die kulturele faktor wat as die mees beduidend gemeet het is 'tyd'. Ander beduidende faktore is opvoedkundige agtergrond, houdings, taal/kommunikasie en waardes. Nie beduidende faktore naamlik, etnisiteit, antropometrie en gelowe is wel beskou as bydraend in die implementering van ergonomika aangesien die populasie wat gemeet is as relatief klein beskou kan word en moontlik in 'n groter populasie as beduidend kon meet.

Opleiding, ingevoerde tegnologie en bestuur is eksterne faktore wat 'n waardevolle en praktiese bydrae maak tot die vakgebied en die implementering van Ergonomika. Kulturele diversiteit voorsien 'n ryk omgewing met verskillende uitgangspunte en indien dit verstaan word kan dit lei tot verhoogde produktiwiteit deur verbeterde gebruik van tegnologie.

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Chapter 1

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

‘Culture’ as an important issue in the design, development and utilization of technical products or systems has been largely neglected by many suppliers as well as receivers of technology in the past.

One of the main reasons for this neglect is the absence of basic information on cultural differences. Very little information exist on both theoretical and empirical analysis of the constraining influences of culture on technology and how this issue should be incorporated in the design of hardware and software technology (Shahnavaz, 1994).

“As all technologies are inevitably associated with socio-cultural values, cultural receptivity of the society, is a very important issue for proper functioning of a given technological design” (Shahnavaz, 1994).

The entire process of technology design and application, from planning, goal setting, and defining design specification to production, management and maintenance system, training and evaluation, is influenced by national or societal culture, which contributes to formation of the collective mental model of people (Shahnavaz, 1994).

“Technology is designed – culturally speaking – within a very narrow band of the international industry, yet it is used throughout the world without any cultural considerations. There are important cultural issues in the transfer of technology; beyond those related to anthropometry and biomechanics. The use of technology involves procedures that are not inherent to the equipment, but which must be designed. Such designs follows Western standards” (Maurino 1994, p.361).

“The authority gradient among operators and users of technology observe that associated to Western cultures. Such gradient is different in other cultures; the quality of feedback processes essential to the proper use of technology suffers accordingly “ (Maurino 1994, p.361).

The International Civil Aviation Organization (ICAO) obtained knowledge about the influence of cross-cultural issues in aviation safety and effectiveness. ICAO came to the conclusion that there are no “culture-free” endeavours. Human endeavours such as human factors, training and design research have strong cultural components.

According to ICAO humans can simply not dissociate themselves from their heritage. “Culture also affects the performance of tasks in various and subtle ways, fostered by social biases, perceptions of status, mental modes and education “ (Maurino, 1994: p. 361).

A solution, which worked in one context, cannot always work in another. The conclusion ICAO came to is that it is not only naïve but also dangerous to accept linear relationship of benefits. “Different contexts present distinct problems which require distinct, culturally-calibrated solutions” (Maurino 1994, p.361).

It has been proven wrong that to simply impose a technology on a society and believe that it will be absorbed and utilized through extensive training (Shahnavaz, 1994).

It is the responsibility of the technology supplier as well as technology receiver to consider the direct and indirect effects of the culture, and make the product compatible with the cultural value system of the user and its intended environment (Shahnavaz, 1994).

Shahnavaz (1994) states that proper application of a technology depend to a large extent on the compatibility of the user’s cultures with the design specification. Compatibility of the societal culture, organizational culture and professional culture has a strong bearing on the people’s preferences as well as the usability of the technology.

South Africa can be seen as a developing country but with elements of developing countries. In the urban areas especially in Gauteng and the

Western Cape, development took place at a relatively fast rate. However, in the rural areas more traditional methods of production are still found.

Large manufacturers with enough capital have the capacity to import or design more sophisticated technology. The small manufacturer simply may not have the knowledge, intention or capital to use such technology. Resistance against new technology may be because of cultural differences. Large or small manufacturers have problems with productivity. The reasons may be culturally calibrated i.e. attitudes, values, knowledge or any other culturally related factors. It may be that technology is imported and the knowledge to use the machinery lack as well as the applicability to the job to be performed.

1.2 A CULTURAL DIVERSITY PERSPECTIVE WITHIN A SOUTH-AFRICAN CONTEXT

South Africa consists of many different cultural groups. With a new political dispensation, freedom of entry and equality in the workplace is created for all groups in the country. These groups include different cultural groups with many differences within workgroups and organizations.

All groups within the society as well as in the workplace need adaptation. With the lifting of sanctions against South Africa the country entered a globally competitive market as a developing country.

Locally as well as in the globally competitive market inhabitants of South Africa have to adapt. The question can be raised whether the country and its workers are ready for such a sudden participation in the fast lane together with developed countries.

Not understanding internal differences such as cultural, race, age, religion and gender differences it is even more difficult when faced with external differences such as those of international countries. When dealing internationally i.e. with Japan, or America, it is not only products and technology that differs but also their culture. People from other countries speak different languages, deal in other currencies, and have different attitudes from local ones. Gestures or phrases misunderstood can cause rotten deals.

Within South Africa eleven different languages are regarded as official. This gives an indication of how communication can be a barrier in the understanding of each other. Groups were separated under the Apartheid era where education took place within certain areas against different criteria. If different cultures locally have difficulty understanding one another it will be even more possible not understanding international cultures.

Differences in the educational background of different cultural groups within the country created and still do create differences at entrée levels to further education institutions or organizations. An example is the bad pass

rate of St.10 pupils of certain cultural groups in the country. The tendency at higher education and further education institutions is more and more towards the admission of students from socially disadvantaged communities. Students from both advantaged and disadvantaged communities are placed together as students with different standards but at the same entrée level. This situation also applies for students who directly enter the workplace.

Toffler (1990) describes the poorer developing countries as the slow countries on the basis of slow economies in comparison with the richer developed countries with fast economies.

In fast economies, advanced technology speeds production. It is not only the technology which is of significance in competitiveness but also the speed of transactions, the time needed to take decisions, the speed with which new ideas are created in laboratories, the rate at which they are brought to market, the velocity of capital flows, and above all the speed with which data, information, and knowledge pulse through the economic system.

“Fast economies generate wealth – and power – faster than slow ones “ (Toffler, 1990, p.389). According to Toffler (1990) tradition, ritual and ignorance limit socially acceptable choices. He describes a “great wall” that separates the fast from the slow. The great wall, being culture and

technology, causes the high rate of failures in joint projects between fast and slow countries.

“Many deals collapse when a slow-country supplier fails to meet promised deadlines. The different pace of economic life between the two worlds make cross-cultural movements static. Officials in the slow country typically do not appreciate how important time is to the partner from the fast country – or why it matters so much. Demands for speed seem unreasonable, arrogant. Yet for the fast-country partner, nothing is more important. Delivery delayed is almost as bad as delivery denied” (Toffler, 1990; p. 394).

The new economic imperative was clear for Toffler (1990) while writing his book that overseas suppliers from developing countries will either have to advance their own technologies to meet the world speed standards, or they will be brutally cut off from their markets – casualties of the acceleration effect.

1.3 PROBLEM STATEMENT

The question raised in this study is: “Which cultural barriers exist in the implementation of ergonomics in the country and the hampers the efficient use of technology? How is the implementation of ergonomics/technology influenced by factors of cultural diversity?”

Within the scope of this study it would not be possible to research all developing countries nor South Africa as a whole. To make research possible this study is conducted in the Eastern Mpumalanga area as part of a developing South African country. Further research is recommended in other provinces or areas of South Africa.

The problem statement for this industrial psychological study is to determine why certain cultural diversity factors influence the implementation of ergonomics in developing countries with specific reference to the transfer of technology within the Eastern Mpumalanga Province as one of nine provinces of South Africa.

It is the purpose of this study to establish to what extent cultural diversity is regarded as important in the organization. The extent of cultural diversity and how it is taken into account at the implementation of technology as well as the regard that management has for cultural diversity in the workforce using technology.

1.4 HYPOTHESIS

The hypothesis set for this study is: Cultural factors influence the implementation of ergonomics in developing countries with specific reference to the transfer of technology.

Specific cultural factors have been identified. So many differences exist between cultures that it is not possible in this study to include all the factors. Some cultural factors may even be unknown and yet to be identified.

1.5 SCOPE OF THE STUDY

This study is conducted in the subject field of Ergonomics where Ergonomics studies the fit between man and machine. The area in which the research was conducted is situated within the Eastern Mpumalanga area - also known as the Eastern Lowveld.

In Chapter 2 the subject field of Ergonomics is defined and discussed in terms of the focus and the objectives of Ergonomics. The extended system model as designed by Calitz (1997) is used to explain the extent of Ergonomics and the interaction between human, machine and environment as a system. The person-centered approach to Ergonomics is then discussed to emphasize the individual as a unique controller of the system.

Chapter 3 looks at the workplace as a place of pluralism where people enter from diverse origins. People's attitudes toward work and working habits are influenced by their cultural background. The experiences and knowledge of people from different cultures differ. They get together in one central workplace where a new 'working culture' is formed. "Application areas

which are affected by differences in culture are work organization, safety, management, maintenance design, manual design, job content, technology choice, work schedule and worker training selection“ (Shahnavaz, 1991, p. 81). Different cultural and related concepts are defined as well as the forming of personalities within culture are discussed to determine the forces which influence an individual’s personality and the impact thereof on society.

Chapter 4 presents technology as the tools and equipment including computers and mechanical equipment used in the production process as well as specific kinds of knowledge. The different techniques used for production serving diverse customers are explained. This chapter emphasizes the practical side of technology.

In Chapter 5 technology and culture is combined to indicate the relationship between culture and technology. Ergonomics as a link between human factors such as culture and technology is discussed.

Chapter 6 presents a discussion of the measuring instruments used in the study and the methodology followed in the empirical part of the study. The results of the study will be revealed in Chapter 7 and this study is concluded in Chapter 8 with an overview.

Chapter 2

ERGONOMICS

2.1 INTRODUCTION

The inter-disciplinary science of ergonomics explores human capabilities and uses his knowledge to improve the design of things that people use and the ways in which they work (Gaddy, Kobor, & Johnson, 1999).

Ergonomics can contribute to the solution of a large number of social problems related to safety, health, comfort and efficiency (Dul & Weerdmeester, 1993).

Ergonomics has different facets for different organizations and the emphasis of ergonomics will be different for each organization defining the field. Central to this is the definition given by Calitz, (2000). “Ergonomics is the science and technology of the interaction between the human and the physical work environment, taking into account the societal context” (Calitz, 2000, Personal communication).

This indicates that the human does not enter his place of work only as a physical structure but with certain social qualities, attributes and experiences. Calitz, (2000) makes technology the concern of ergonomics

when he defines technology as: “, being the consciously designed or created set of artifacts or systems used to complete a task, as obviously part of the physical environment ...” (Calitz, 2000, Personal communication). From this it is clear that as important the human structure is the technology in the physical working environment. Complementary to one another tasks can be optimally performed.

Ergonomists are scientists who have specialized in the study of the interaction between people and the things they come into contact with – particularly artificial things. Their work yields information that helps other specialists, such as designers and engineers, to improve the usability of the products they develop (Garner, S, 1999).

Ergonomists, interacts with other specialists like physiologists and psychologists, engineers and others to maximize the interaction between man and designed products such as machinery or tools used in the execution of duties.

2.2. HISTORICAL DEVELOPMENT OF ERGONOMICS.

The designing of products to suit the bodies and abilities of people is not new. During Prehistoric times people already shaped their tools and weapons to make them easier to use. In the 20th century the search for

efficiency of effort and the requirements of mass manufacturing have stimulated research (Garner, S, 1999).

Ergonomics is used traditionally in Industrial Countries for optimizing the human performance and well-being and enhancing the effectiveness of facilities that people use for achieving higher productivity, improved worker health and greater worker-satisfaction (Shahnavaz, 1991).

With the outbreak of the Second World War, ergonomics developed into a recognised field. During this war the whole world saw a rapid development in the military field. Military equipment developed in response to the need to fight in different environments, with different kinds of people and using different approaches and soon became extremely complex and problematic (Osborne, 1995).

Technology and the human sciences were systematically applied in a co-ordinated manner for the first time during the Second World War in Europe. Physiologists, psychologists anthropologists, medical doctors, work scientist and engineers together addressed the problems arising from the operation of complex military equipment. The results of this interdisciplinary approach appeared so promising that industry pursued the co-operation after the war. The interest in the approach started to grow rapidly in Europe and the United States, and lead to the foundation in England of the first national ergonomics society in 1949, which is when the term 'ergonomics' was

adopted. In 1961, the International Ergonomics Association (IEA) followed, which represents active ergonomics societies (Dul & Weerdmeester, 1993).

Today Ergonomics is represented by the International Ergonomics Association globally in many countries. Congresses are held annually where presentations take place by different researchers and Ergonomists on various aspects of ergonomics.

Increasingly, designers and engineers rely on human-factors research, such as anthropometric data (body measurements) and experimental usability studies, to aid the process of making products easier to understand, safer to use, and better matched to the human body. The elderly, children and disabled people are special groups with which ergonomics analyses may be concerned (Garner, S, 1999).

Ergonomics is a useful tool for evaluating the choice of technology and the implementation thereof. It can contribute to the safe and productive transfer of technology and reduces the number and scale of accidents and any possible catastrophes of industrial operations.

2.3 THE NATURE OF ERGONOMICS.

Shahnavaz (1985) defined ergonomics as an applied science, which is concerned with the characteristics of people that need to be considered in

designing and arranging things that they use in order that people and things will interact most effectively and safely.

Ergonomics is a concept, an idea. It is a way of looking at the world, of thinking about people and how they interact with all aspects of their environment, their 'equipment' and their working situation (Osborne, 1995).

The word 'ergonomics' is derived from the Greek word 'ergon' (work) and nomos (law). In the United States, the term 'human factor engineering' is often used. Ergonomics aims to design appliances, technical systems and tasks in such a way to improve human safety, health, comfort and performances (Dul & Weerdmeester, 1993).

Osborne, (1995) stated that people invented machines. According to him we want the interaction between machinery and people to be effective. It is appropriate that we attempt to remain in full operation control of the system within which we are working. To ensure optimum interaction, the 'machines' and the working environment in which they operate must be designed to fit people's thoughts, wishes and abilities (Osborne, 1995).

'Machines' is used in the general sense of a physical component or set of components which assists a human being in the performance of some actions. Thus, a machine tool is a machine but so also is a bus, a screwdriver or a kitchen sink (Shackel, 1974).

Ergonomists view working situations by understanding how people behave at work, how they interact with their environment and their machines at both physical and emotional levels, working environments can be created that do not require more of the operator than the operator can give. The ergonomic argument concludes, that when people and machines are in harmony, productive output will increase (Osborne, 1995).

Equally important to the relation between machine and human, ergonomics becomes involved with the problems of interaction between humans and the organization of the system, especially in its information and communications aspects (Shackel, 1974).

Ergonomics is an applied science, which is aiming to match the demands of products, jobs and places of work with the people who use them (Shahnavaz, 1985).

The interaction of characteristics of people and of things or technology used by them, involve two opposite aspects. Characteristics of humans involve abilities, feelings, personalities and life experiences. Technology or anything used to perform the task of man is designed by humans and is lifeless. In the attempt to fit both humans and technology efficiently it is important to study both fields as well as the environment they originate from and work in.

2.4 THE FOCUS AND OBJECTIVES OF ERGONOMICS.

To apply ergonomics effectively the approach should be to gather relevant information in a systematic way about human abilities, characteristics, behaviour and their motivation. This will enable ergonomics to focus on reaching the objectives of effectiveness as well as to maintain human values in the process.

2.4.1 THE FOCUS OF ERGONOMICS

According to Shahnavaaz, (1985) the focus of ergonomics is that people and their requirements should be considered when:

- (a) Objects, facilities, systems and environments which people use and operate within, are being designed and developed.
- (b) Procedures for people to carry out work and other activities are being developed.
- (c) Objects, facilities, etc., which involve and affect people are being evaluated.

2.4.2 THE OBJECTIVES OF ERGONOMICS.

- (a) “To enhance the effectiveness with which work and other human activities are carried out.

- (b) To maintain or enhance certain desirable values in the process, e.g. health, safety, satisfaction” (Shahnavaz, 1985, p.2 -3).

In the extended human-machine systems model of Calitz, (1997) the objectives of ergonomics are being explained through two aspects: productivity and quality of life.

OBJECTIVES OF ERGONOMICS

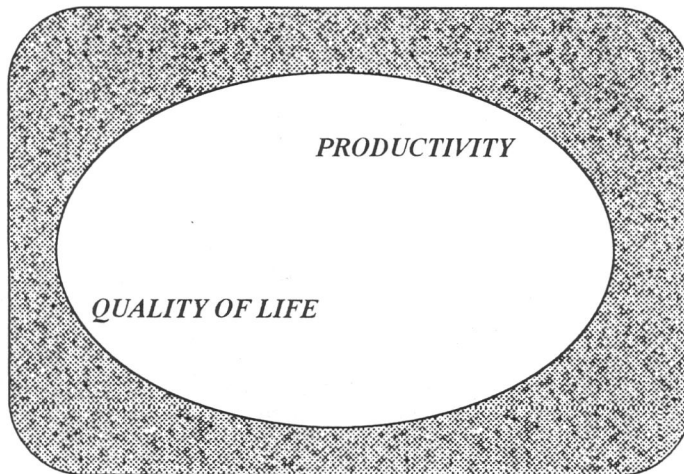


Figure 1: Productivity and quality of life

(Calitz, 1997)

2.6 ERGONOMICS AND SYSTEMS.

To explain the interaction between human, machine and environment Calitz (1997) developed a holistic systems model. The extended human-machine systems model is presented in (Appendix A).

This graphical model is valuable in that it covers the 'bigger picture' of the subject field of ergonomics. The focus of practical Ergonomists tend to be on the human-machine interaction. Newer emphasis however, such as Micro-ergonomics, Information processing, Human-computer Interaction, Software ergonomics, Cultural diversity and Ecological ergonomics criticize definitions and models of Ergonomics (Calitz, 1997). According to him approaches from different subject disciplines have created parallel rather than converging viewpoint and activities.

2.6.1 A COMPREHENSIVE SYSTEMS MODEL OF ERGONOMICS.

This model is holistic, follows the systems approach, and it presents a hierarchy of components from context through the ambient environment to display and control interfaces as well as intra-personal and intra-machine components. It shows the interactions between facets emphasizing information processing as a core dynamic process rather than a separate kind of Ergonomics. It also includes culture as one of the coherent factors (Calitz, 1997).

2.6.2 THE DYNAMICS OF THE EXTENDED SYSTEMS MODEL.

According to Calitz, (1997) one can start this model anywhere, from the outside - to get the bigger picture - or from the inside. "Follow the arrows

(representing information) in a generally clockwise direction. Feedback loops are arrows pointing in the reverse direction” (Calitz, 1997, p. 180).

“The core of the model is the human and the machine, which each has input, processing and output capabilities as well as ‘higher’ functions and a construction or body. (A machine is considered being any human-made object used to complete some task and could range from a simple hand tool to a vehicle or complicated electronic equipment.) The human and machine interacts by interfaces (displays and controls to complete a defined task, a multitude of which combines to form a job). Surrounding this is the immediate physical environment (the ellipse), with the factors mentioned on the left perhaps more directly influencing the human. All of the above interact with the four broader contexts and the two physical environments” (Calitz, 1997, p.180).

“The historical context includes past events and culture. The political background also refers to laws, regulations and standards required by the country and local government. The economic environment refers to the available finances and the technological level of the organisation or section. The social environment could be co-workers or teams, but refers mainly to managerial style and actions” (Calitz, 1997, p.180).

“The built environment includes buildings, facilities and transport. The natural environment is the important ecological factors, energy, waste management, littering and all the “green” concerns” (Calitz, 1997, p.180).

Safety is regarded as important and according to Calitz, (1997) should feature in any comprehensive model. An error or accident could be the result of a deficiency anywhere in this model. Safety (and effectiveness) would be the result of the components all functions well.

During the planning phase, from the start of designing a Man-Machine system, it is important to consider together with design consideration for the physical properties of the system (i.e. the mechanical functions) also the operator’s function (i.e. retrieving of information, control and operation) (Shahnavaz, 1985).

Traditionally the approach has been to consider only the physical functions (i.e. the engineering part). The operator’s functions have only been considered when it became a limiting condition for the use of the machine and has been of minor importance. The result was that the maximal effort of the operator has been necessary to meet the minimal requirement of the machine (Shahnavaz, 1985).

In a machine-operated approach, especially where the designer is different from the socio-cultural society who is the user, the human operator cannot

be maximally efficient. “Forcing people to interact on the machine’s terms is not only inconvenient ...more importantly, because it is an unnatural mode of interaction, it is a primary cause of human error” (Norman in Shahnnavaz, 1985).

According to Meister, in Shahnnavaz (1985) the operator is an integral part of the system, he must be considered in the design and the functions he performs must also be developed as part of the whole systems design.

Shahnnavaz (1985) states further that instead of adapting the human to the machine, one should preferably adapt the machine or at least try to fit them together, so that maximal requirements of the machine can be met with the minimal or most with moderate effort from the operator. He states that it is easier to redesign a piece of machinery or system than to change people.

“In a ‘human operated’ approach the operator is not considered as a part of the machine nor as a factor of production, but rather as a person with needs, aspirations and attitudes, a cognitive system interacting with another in the control and operation of the process” (Shahnnavaz, 1985, p.7).

To optimally integrate this system it is important to have maximum information of human, machine and environment. This study attempts to understand the background and origin of the human and his environment by

investigating the cultural factors that can cause misunderstanding in the workplace where technology has to be used.

The 'Extended Man-Machine System model' is useful for this study in that it acknowledges all aspects of the human being including the cultural and historical development of the human. It also indicates the interaction of the human and cultural background with the 'bigger' process.

The cultural and historical background of human beings include many facets such as time concepts, educational background, religious beliefs, ethnicity values, attitudes, language and communication differences, and many others. This model is comprehensive in that ergonomics as a subject field can be understood in all its spheres which includes the human-machine interaction and the environment in which it operates.

The person-centered ergonomics views in the following point will be discussed in an attempt to understand the human being better. The person-centered aspects are also covered by the 'Extended Man-Machine Systems model' where in the center of the model the human body together with his/her abilities, personality, attitudes, values, motivational and memory system is made part of the system through inputs and outputs while performing his/her tasks.

2.7 PERSON-CENTERED ERGONOMICS.

Although in its traditional guise ergonomics argues that, for efficient operation of the system, individuals and their working systems should operate in close harmony, contemporary thinking suggests that even this seemingly innovative philosophy has its shortcomings. Recent arguments have advanced the thesis that the operator and the system are not equal partners at work: indeed, to consider them as being so in some way denigrates the most important component in the system – people – and reduces them to the level of inanimate components. Thus, the modern, person-centered view of ergonomics argues that it is the person who controls the system who operates it, steers its course and monitors its activities. In doing so it is the operator who has goals and wishes and who can change the system through abilities (Osborne, 1995).

Osborne (1995) argues it naturally follows that for the system to be effective it should be designed from the primary viewpoint of the operator – and not so much from a symbiotic (operator/machine) perspective.

In short, the traditional man-machine concept is too simplistic for the operation of modern working systems that require people to be at the center.

Discussing the human-computer interaction domain, for example, Eason in Osborne (1995) argues that the basic human-machine viewpoint (as a form of

conversation between different kinds of participants) misses the rich complexity of the interaction. He points out that in the real world we interact with machines not merely to exchange messages but to engage in complex tasks. The human-machine interaction has a meaning, which is over and above that which can be expressed by simple, straightforward analyses of the component parts. Both the operator and the nature of the task and its outcomes inject his meaning into the system (Oborne, 1995).

Wisner in Osborne (1995) considers this viewpoint within the full domain of ergonomics. He argues that what is specific to ergonomics, as well as to psychology, is that it should attempt to 'understand' how the human uses his own properties in terms of a story, his own story and that of humanity, the part of humanity to which he belongs. Individual wishes and desires, motives and experiences are brought to a working situation and must be understood when considering the 'fit'. Factors such as social background and culture play an important role.

The person-centered view of ergonomics, therefore, considers the interaction as one that is controlled and guided by the operator(s) in the system.

In the course of their interactions with it, people bring to the system a collection of inherent strengths and weaknesses (including experiences, expectations, motivations,) which themselves will interact with the system

to change it. Often such features will be to the good of the system, from the viewpoint of such criteria as efficiency and safety. But sometimes they will include variability and fallibility – each of which is more likely to lead to errors and inefficiency.

The traditional, almost mechanistic ergonomics philosophy can be said to have misperceived a critical perspective of the system in which it is involved – the operator and the attributes which he or she brings to the system in the wider sense. So, rather than just concentrating on ways of improving the information flow between individual components, person-centered ergonomics takes as its central point the need to accommodate the human attributes that the person brings to the system (Osborne, 1995).

In many respects, of course, the traditional and person-centered perspectives can be viewed as being variations in emphasis as to which are the most important components within a system. The traditional view emphasizes the individual as being almost subordinate to the system: the person-centered view concentrates on the individual as a unique controller of the system.

By taking such a position, however, the person-centered approach loses none of its thrust towards the ideal of creating working environments that will fit the abilities and requirements of human operators.

Put in another way operators in a system inevitably turn it from being a closed-loop system to an open-loop one. Instead of information flowing from one component to the other with (in theory) maximum efficiency for correcting deviations within the system, deviation corrections are effected by the operators on the basis of their 'mental models' of the system and its operation (Branton in Osborne, 1995).

2.8 CONCLUSION

Ergonomics forms the crux of this study where cultural diversity is studied as an outflow of the extended system model as well as the modern person-centered view of ergonomics.

It is important to fully understand how man uses his own properties when working at his workstation. By examining the interaction of factors such as social background and cultural differences and the system and its operation an attempt is made to have a better understanding of man and machine. The implementation of new technology involves new tools and machinery as well as the human operators. Therefore adjustments might be needed to make technology fit the operator in terms of their "mental models". Humans also have an active role to play in this adjustment process by adjusting their attitude towards changing technology.

Ergonomics is the study which deals with this fit of the human being to his physical environment and is of vital importance to every company using any kind of technology.

Cultural diversity indicates human differences. People who are different in the way they think and act can cause misunderstanding, which can be costly to an organization. By understanding cultural differences between humans and by accepting that certain cultural factors cause them to act differently can create an optimal operation of the systems model of Ergonomics within any organization.

Chapter 3

CULTURE

3.1 INTRODUCTION

Culture, entails beliefs, behavior, language, and an entire way of life of a particular time or group of people. Culture includes customs, ceremonies, work of art, inventions, technology, and traditions. The terms may have a more aesthetic definition and can describe the intellectual and artistic achievements of a society (Microsoft, 1999).

According to Vos (1998) the way in which, values, attitudes and perceptions of individuals are formed by their ethnic, racial and cultural backgrounds, contribute to the uniqueness and individuality of each individual.

Ergonomics is challenged today to facilitate the harmonious functioning of people, machines and organizations and to contribute towards a future society in which individuals and organizations can grow in meaningful contexts (Richardson, 1994).

Work organizations are meeting places of pluralism of views where people consider, negotiate and 'gloss' their perspective and perform interrelated actions at a very high level of 'situated' action. People's cognitive constructions in social groups constantly undergo change through the

symbols of language, gesture and action, which take importance through an on-going attribution, and interpretation of things, objects and phenomena. The interpretation people make of the behavior of others around them will lead them to respond in ways which will become incorporated reflexively into their view of work. It is through activities and in the understanding of “how to go on” that the social world of work is made meaningful to them (Blumer in Richardson 1994).

According to Blumer in Richardson (1994) the work culture that emerges from this complex, fluid world of social interaction is continually changing and is shaping people and events. The actions and decision making of each individual in an organization, regardless of rank or job, will collectively shape the work culture. In the workplace, as everywhere else, human life can be seen as a ‘developing process’ instead of a mere issue of productivity of psychosocial structure.

Culture can be seen as the medium through which peoples’ understanding of work practices, attitudes and behavior are formed and shaped and can be inferred not observed through behavior (Wolcott in Richardson, 1994).

“People’s attitudes toward work and working habits are also influenced by their cultural background. For instance, in some parts of the world there are strong biases against tasks or occupations associated with ‘dirty hands’.

These attitudes are also reflected in lower average pay scales for people in such occupations “ (Shahnavaz, 1991, p.80).

This seems to be an international problem. Shahnavaz (1991) states that one reason for the scarcity of professional practical engineers among the educated Vietnamese is that engineering is considered a low-status occupation. The most popular courses in their universities are liberal arts, languages, and the humanities.

Furthermore, according to Shahnavaz, (1991) top-level managers in some countries may be appointed because of political influence or family status rather than because of their experience or knowledge. “Their lack of expertise, together with their “no dirty hands” attitudes, makes for inadequate supervision of maintenance operation “ (Shahnavaz, 1991, p.80).

Segal and Zellner, (1992) in Greenhaus & Callanan, (1994) raise their concern about organizations’ ability to manage diversity on the suspicion that women and minorities are not growing in their careers to a degree commensurate with their talents. Although 41 % of all managers are women, only 3 % of top managers are women. The concern is raised by Greenhaus, (1994) that if women and minorities faced substantial obstacles in reaching the top levels in organizations in the past, how can organizations be expected to manage an increasingly diverse group of employees.

“Application areas which are affected by differences in culture are work organization, safety, management, maintenance design, manual design, job content, technology choice, work schedule and worker training selection“ (Shahnavaz, 1991: p.81).

It is the purpose of this study to identify specific factors of cultural diversity, which causes the differences in the workforce of a company. Furthermore is it important to find whether such cultural factors have in influence on the application of ergonomics in the workplace. If cultural factors are known and understood it can be managed effectively. Higher productivity will be possible through more effective use of technology. Ergonomics can play a vital role in the understanding of cultural factors in such a way that harmony can be established between human factors, technology and the environment.

3.2 DEFINING CULTURE AND RELATED CONCEPTS

- Culture

Culture, as the term is applied, to organization, has been defined by Shein in Nickerson, (1992) as “(a) a pattern of basic assumptions, (b) invented, discovered, or developed by a given group, (c) as it learns to cope with its problems of external adaptation and internal integration, (d) that has worked well enough to be considered valid and, therefore (e) is to be taught to new

members as the (f) correct way to perceive, think, and feel in relation to those problems” (Nickerson, 1992, p.34).

Bair in Nickerson, (1992, p. 34) defined culture simply as “the common awareness among people that forms a collective understanding for perception of events”.

Cultural diversity reflect on any differences that exist between groups of people on basis of factors such as race, ethnicity, language, rituals, religious preferences, values and attitudes.

- **Ethnography and culture.**

Ethnography aims to provide a description of the group of people under investigation from own perspective on a premise that each person is an ‘active attacher’ of meanings to the world (Cuff and Payne in Richardson, 1994).

It takes into account the cultural background of situated action. Ethnographic methodology incorporates naturalistic modes of inquiry within an interpretative or constructive research paradigm and analysis of data helps to trace the process of culture formation. This can help to promote an understanding of why people behave as they do at work and implications can be drawn, which can be translated into training programs (Wolcott, in Richardson, 1994).

According to Shahnavaaz (1991) within every country is its history, tradition and culture which, determines and shapes the way of thinking and reacting.

The way in which people approach learning appears to differ markedly amongst cultures. Shahnavaaz (1991) used the example of the way of learning for people in the Orient that is largely accomplished through imitation, memorization and rote.

“This is also true of theoretical or conceptual material as well as of more practical skills. There is a tendency to believe that having learned the words one has also acquired understanding and knowledge” (Shahnavaaz, 1991, p.80).

People learn at each moment of their lives through a continuum of learning which results from continually responding to ecological features of their total social environment. The purpose of thinking is to learn to act effectively in situations. People learn through their “being” there. Cognition is distributed over mind, body and the activity, situated in a culturally organized setting (Rogoff in Richardson, 1994).

Thinking is driven by processes of perception which are socially situated and which are rarely, if ever decontextualised. The learning process occurs, as a result of constructions of a schema developed through the integration of

the totality of an experience in a specific context and culture whether or not here is any purposeful input. Schema is built on a continual basis and thinking is borne of the moment. Any one set of schemata will become more prominent and embedded in memory through their recurrent recall in situations which are perceived to have a similarity of features that trigger that recall (Rogoff in Richardson, 1994).

- **Intercultural communication**

It is known that both verbal and non-verbal behaviour differs in their meaning across cultures. People who travel the world in a sensitive and perceptive way can give examples of how a phrase or a gesture has led to inadvertent misunderstanding and sometime ribald reactions. Even between relatively close cultures, such as the UK and US, the same everyday word or phrase can have a totally different meaning which again, if used out of context can have embarrassing consequences (Randell, 1994).

In South Africa where eleven different languages are used as part of eleven different cultural groups it can lead to misunderstanding of one another or of a job to be performed.

Randell (1994) provide tentative support for the view that a common core of appropriate verbal behaviour in interpersonal management could transcend culture. This core could be established by identifying similarities in the effects of different kinds of communication across cultures.

- **Acculturation**

Acculturation refers to the process whereby people adapt to an eco-cultural system which is not their own. Some of the settings of acculturation are migration and immigration, adapting to prison, school or army, urbanization, westernization, industrialization and industrial change (e.g. automation of existing processes), etc. (Du Preez in Vos, 1998).

Acculturation is explained by Vos (1998) as being distinguishable between instrumental and integrative acculturation.

“Instrumental acculturation implies that people adapt to another culture for specific and limited objectives, maintaining their own culture and in-group while retaining the option of withdrawal from the host culture.”(Vos,1998). He stated further that the conditions, which ruled at the time of forced migratory labour in South Africa, serve as a good example of instrumental acculturation.

Integrative acculturation according to Du Preez in Vos (1998) is a form of acculturation in which newcomers hope to become no different from the members of the target culture. Many factors contribute to the success or failure of this process, including the presence of ideologically marked distinguishes such as race, religion and sex.

Although culture vary in strength in degree of internal consistency with such factors as the stability of the group, the length of time it has existed, and the strength and the clarity of the of the assumptions held by the group's founders and leaders (Nickerson, 1992).

Culture will become an increasingly important concept for organizational psychology because without it, it is not possible to understand change or resistance to change (Shein in Nickerson, 1992).

This statement can be applied to a New South African situation where changes to be made is based in many situations on cultural factors. To successfully change or to handle resistance to change the cultural differences between people will have to be taken seriously.

- **Cultural Diversity**

Rentch, Turban, Hissong & Marrs, (1995) in Vos (1998) state that there is not an accepted definition of cultural diversity, but, in general, cultural diversity refers to an awareness of differences among workers in terms of a number of such dimensions as race, sex, age, socio-economic status, and lifestyle.

- **Organizational culture.**

Organizational culture has been viewed as an intangible but real and important factor in determining the organizational climate. The

conventional wisdom about culture is that it is “the glue that holds the organization together” (Sherman, Bohlander & Snell, 1996, p.72).

Organizational culture is defined as the shared philosophies, value assumptions, beliefs, expectations, attitudes, and norms that knit an organization together (Sherman et al., 1996). Sherman et al., (1996 p. 72) further describes it, as “the way things are done around here”.

Elements of culture within the organization.

Terrence Deal and Allan Kennedy in Sherman et al., (1996) made an exhaustive study of the organizational literature to make the elements that make up a strong culture more understandable. Five elements were found by them and is described as follows:

1. Business environment. The business environment is the single greatest influence in shaping its culture. Each organization carries on certain kinds of activities – production, selling, inventing, conducting research.
2. Values. These are basic concepts and beliefs that define ‘success’ in concrete terms for employees – e.g., “if you do this, you will be a success.”
3. Heroes. People who personify the culture’s values provide tangible models for employees to follow. Organizations with strong cultures have many heroes.

4. Rites and rituals. The systematic and programmed routines (rituals) of day-to-day life in the organization show employees the kind of behavior that is expected of them and what the organization stands for.
5. Cultural network. Through informal communication the corporate values are spread throughout the firm.

“A strong culture not only spells out how people are to behave, it also enables people to feel better about what they do, causing them to work harder ” (Sherman et al., 1996).

- **Risk management and acculturation in the workplace.**

The process of acculturation into a concept of risk at work will, by its nature, only take place in settings perceived to be risky. Situated cognition will determine situated actions. This challenges traditional training in risk prevention where skills are often learned in decontextualised environments with the expectation that they will transfer into the workplace through a largely random process (Rogoff in Richardson, 1994).

The International Civil Aviation Organization (ICAO) suggested that accident statistics are the measure of the system's health. Statistics however, reveal a sequence of cause-effect relationships but fail to reveal the processes involved in such relationships. It was only recently that the

processes – including cultural issues – involved in safety management have started to be acknowledged (Maurino, 1994).

“The notion of safety is intimately related to the perception of what constitutes risk and, ultimately, to the value of human life. Both vary significantly among societies, as a function of religion, ethics and moral. An unacceptable risk within one society may not even be acknowledged in another ” (Maurino, 1994, p.361).

People at work learn through their whole experience at work. They continually assess and make judgements and decisions for their actions from a multitude of pervasive covert and overt feature of innuendo and gesture in the work context. Individual on-going actions of safe behavior will be established only by interpenetrating the flow of learning, which occurs naturally with a purposefully developed workplace culture that positively reinforces the concept of risk prevention and provides the scaffolding for individual orientation toward a concept of risk (Richardson, 1994).

Studies of the complexities of personal identity, inter-subjectivity and cultural context in which workers and their managers make sense of risks to health, is fundamental to implementing risk management programs which will form the basis of enduring safe systems of work. The individual cognitive and affective dimensions of musculoskeletal stress, as well as the individual nature of concept of risk point to a need to consider not only the

quality of the information that is being disseminated in training but also how the information is received and acted upon in the workplace. Knowledge alone will not guarantee safe practice (Richardson, 1994).

In order for training programs to function powerfully in developing safe systems of work they must be delivered and understood in a way which incorporates the many perspectives and models of work observed in the workplace (Richardson, 1994).

- **Personality and culture**

The following definition of the individual's personality indicate the influence of culture on personality:

“An individual's personality is a relatively stable set of characteristics, tendencies and temperaments that have been significantly formed by inheritance and by social, cultural and environmental factors. This set of variables determines the commonalties and differences in the behavior of the individual”
(Ivancevich & Matteson, 1990, p. 86).

A number of different factors determine the nature of an individual's personality. Obviously a key factor in the determination of personality is heredity. While the genetic background inherited from our parents does not absolutely determine the precise type of personality we will have, it does

profoundly influence and constrain the type of personality each of us develops.

Cultural factors play a broad and general role in the development of individual personality. Different cultures encourage and prohibit different types of behavior and attitudes, and this broad social and cultural norms influence the nature and development of the personalities of the members of the cultural group.

Social factors have a direct and pervasive impact on the nature of personality. We are each profoundly influenced by our interactions with other people. Parents construct the world for their children when they are very young. Throughout our lives friends and peers influence what we do and how we develop.

The people with whom we interact, our environment and the situations within which we find ourselves also influence our personalities. The types of experiences that we have and the contexts within which we have them can strongly influence the development of personality. For example, personality development is influenced by where we live, what schools we attended and what kind of organizations we have worked in (Arnold & Feldman, 1986). Forces that determine the individual's personality are presented in a model (Figure 2), in Ivancevich & Matteson (1990).

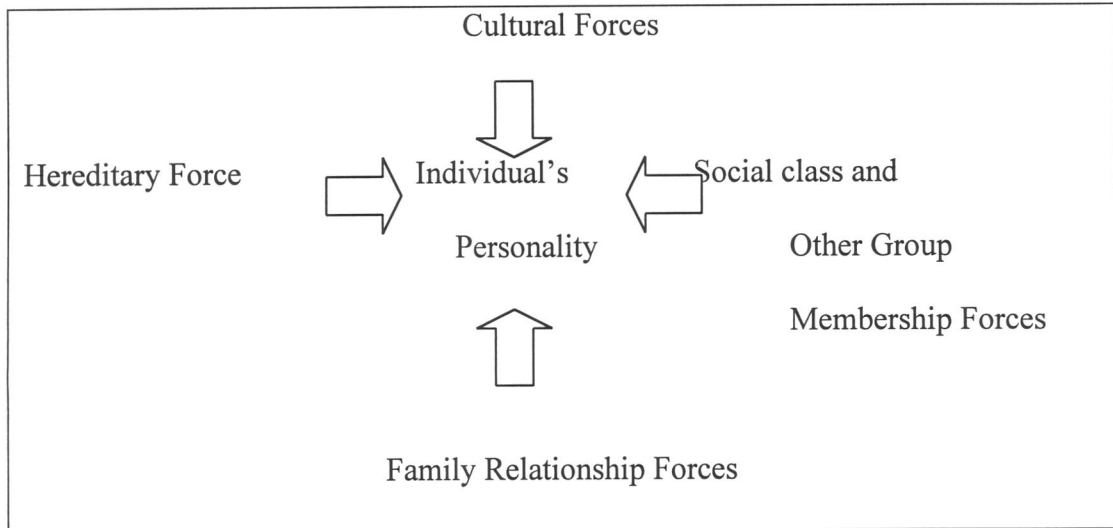


Figure 2: Major forces that determine individuals' personality.

(Ivancevich & Matteson, 1990)

The impact of culture in shaping our personalities happens gradually. The stable functioning of a society requires that there be shared patterns of behavior among its members and that there be some basis for knowing how to behave in certain situations. To ensure this, the society institutionalizes various patterns of behavior. The institutionalization of some patterns of behavior means that most members of a culture will have certain common personality characteristics (Ivancevich & Matteson, 1990).

Arnold & Feldsman (1986) uses a model of individual behavior and performance in which it becomes clear that people are the basic building blocks of organization. The distinctions, which are drawn, between the behavior, the performance and the effectiveness of individuals in

organizations are important ones. Individual behavior refers to the concrete actions engaged by a person.

The behavior of organization members is the primary concern of management, and it is essential that managers have an understanding of the factors influencing the behavior of the individuals they manage.

3.3 CULTURAL DIFFERENCES AND MANAGERIAL STYLES

Hofstede in Vos (1998) pointed out that managerial models developed in one culture may not easily translate to another because of the different traditions and values of the management and workforce.

Differences in cultural values and the implication thereof on managerial style and managerial development are set out by Vos (1998) as follows:

- i. **Human nature.** “Societies’ predominant perception of human nature with man regarded as predominantly good at one end of the spectrum, and naturally bad at the opposite end.
- ii. **Time.** Different societies perceive time differently. To Westerners’ time is an unending continuum that can be subdivided into precise units which form part of an interlocking logical system, other than Asians who do not appear to take time as seriously and is not used to precise scheduling and punctuality. Expressions commonly used by

Westerners concerning time are “on time”, “find time ‘ etc. (Du Preez in Vos 1998).

- iii. **Family relationships.** Hofstede in Vos (1998) places societies on a continuum of individualism versus collectivism, with Western societies falling near the individualism end and most Asian societies near the collectivism end.
- iv. **The relationship between man and nature and the Supernatural:** Western nations emphasize individual rights while Asian cultures emphasize the individual’s duties towards his family and community. Du Preez in Vos (1998) describes the “ubuntu” phenomenon amongst South African Blacks as being in contrast with Western cultures where competitiveness, individualism and materialism are exercised, while Blacks emphasize collectivism and commitment to the group. According to Ubuntu ethics sympathy and help is provided to those in need while the dignity of all people is respected. Individuals may achieve, but only within the context of society and the group” (Vos ,1998, p.54).
- v. **Activity:** Westerners are generally considered more aggressive in everyday life than Asians. More emphasis is placed on individual rights and achievements and is more tolerable towards odd and creative people. Asians tend to be more passive and defensive,

striving for social harmony even at the expense of efficiency. The Asians tendency corresponds well with the Ubuntu ethics found amongst South African Blacks.

It becomes clear from the explanation above that managerial approaches and styles common in one culture may not necessarily apply to another because of the differences in traditions and values.

Shahnavaz (1991) states that transferring managerial and organizational methods from Western societies to Industrial Developing Countries seems to face serious problems. Due to differences of culture, traditional habits, living levels and social, political and economic conditions, many proven managerial and organizational methods in Industrial Developed Countries probably could not be successfully applied or do not work satisfactorily. A further example is that among some communities in India a job is generally regarded as a family responsibility and is collectively performed by all family members (Chapanis in Shahnavaz, 1998).

“Application areas which are affected by differences in culture are work organization, safety, management, maintenance design, manual design, job content, technology choice, work schedule and worker training selection ”
(Shahnavaz, 1991, p.81).

3.4 CONCLUSION

Cultural diversity factors can be studied as variables, which can have an influence on the implementation of technology and thereby have a direct influence on the principles of Ergonomics in an organization.

Cultural diversity within a workgroup using technology as well as cultural diversity of recipient countries of imported technology is considered.

Two aspects are of importance. **Firstly** South Africa is a country with a diverse nation where different cultural groups work together. Many different ethnic groups work together within one organization and each bring certain qualities and properties to the workplace which are seen as possible variables causing the application of technology to be influenced. **Secondly**, many organizations import technology from abroad from nations with cultures different from our local cultures. It is the purpose of this study to find whether the above cultural differences possibly have an influence on the application of technology in the workplace.

Chapter 4

TECHNOLOGY

4.1 INTRODUCTION.

Technological progress has always been crucial to world economic growth. For example, the steam engine, the internal combustion engine and the computer all had a major impact on economic growth. One of the consequences of modern, highly developed technology is that it requires a sophisticated, well-trained labour force to install, operate and maintain the specialized equipment. Capital, technology and skilled labour have become highly interdependent in the process of economic growth (Mohr et al., 1995).

The term 'technology', invariably let us think about machines. The most common meaning of the word technology is the tool and equipment used to transform raw materials into finished products. Technology involves the use of any tools of mechanical or informative nature e.g. computer systems or any workstation where the handling of controls are needed in the execution of tasks.

Advance in the computer industry is rapid. According to Calitz, (2000) it's uses and all its applications are considered to be high technology. Information technology programs improve at a fast rate. Effective implementation of information programs involves ongoing training and purposeful application to the workplace. Programs must fit the need of the organization to be effective.

Production occurs when inputs are combined to produce output. According to Mohr, Fourie & Associates, (1995) the inputs are not combined in a haphazard manner. For a given state of technology, there is a relationship between the quantity of inputs and the maximum output that can be obtained from these inputs. This relationship is called the production function.

The production function depends on the state of technology. When technology changes, the production function also changes. To many people technology is synonymous with equipment, for example computers. To economists technology refers to specific kinds of knowledge (Mohr et al., 1995).

“Technology is society’s pool of knowledge regarding the industrial and agricultural arts. Technology consists of knowledge used in industry and agriculture concerning the principles of physical and social phenomena (such as the application of various aspects of genetic theory to the breeding

of new plants), and knowledge regarding day-to-day operation of production (such as the rules of thumb of the skilled craftsman).

Note that technology is different from the techniques in use, since not all that is known is likely to be in use. Also technology is different from pure science, although the distinction is not very precise. Pure science is directed toward understanding, whereas technology is directed toward use” (Mohr et al., 1995, p. 311).

If we consider a manufacturing plant as an example of an organization using machine technology, it is essential to take into consideration the knowledge and skills needed to design and to use the machines as part of technology.

Arnold and Feldman (1986) define the word technology as the transformation process by which mechanical equipment and intellectual skills are used to produce the organization’s goods and services.

In the case of an auto manufacturing plant, technology transforms raw materials such as steel and rubber into finished cars. The technology consists of the machinery, the knowledge and skills needed to design and operate the equipment, and the mechanisms used to coordinate and control the production process.

Technology is seen everywhere. From the home to the workplace the human is expected to use technology in any form. Whether it is electrical appliances at home or a computer or a manufacturing plant. The success in the use of technology depends on the knowledge and the need humans have to use them. The type of technology used will depend on the kind of task that has to be performed. The wrong choices of technology can be detrimental to efficiency.

4.2 TYPES OF TECHNOLOGY

Arnold and Feldman (1986) classify the best known types of technology according to Joan Woodward, a British industrial sociologist. into three types: (1) Unit technology (2) mass production; and (3) continuous production.

- **Unit Technology** – in these industries the organization transforms raw materials to meet the particular preferences of the customer. The unit of production is made to order for the customer. A wide variety of techniques are used to produce the unit.

The custom home construction industry and the home furnishings industry are examples of unit technology. For instance, in the custom home construction industry, different floor plans and spatial configurations are developed for individual home purchases. In the

home furnishings industry, kitchen cabinets, bathroom fixtures and several types of build-in bookcases and fireplaces are made to order for the customer. Different techniques are used to produce the various units for the different customer.

- **Mass Production Technology** – In these industries, standardized operating procedures are used to produce standardized products. The same technology and the same operations can be repeated over and over again.

Many segments of the automobile manufacturing industry and the consumer goods industry (e.g. cosmetics, canned food, and paper products) use mass production. The same technology is used repeatedly to produce standardized products. The same control and coordination mechanisms can be used to produce each good; the skills needed to produce each good do not vary; the same tools and equipment can be used repeatedly.

- **Continuous Process Technology** – The manufacture of chemicals the production of pharmaceuticals, and the refining of oil are all examples of continuous process technology. Continuous process production technology often involves the production of liquids or gaseous substances.

This technology is called continuous because the chemicals that are made from one stage of processing to another, usually without being handled at all by the workers. Automatic controls are used to regulate much of the technology: much of the process is mechanized. Most of the personnel in these firms are professional scientists who design the production process, and highly trained technicians who monitor and maintain the machines and equipment (Arnold & Feldman, 1986).

From this discussion of technology used it becomes clear that the kind of technology used in the production process will determine the knowledge, skills and abilities needed to perform the tasks. The type of technology will have an influence on the structure of the organization.

4.3 CONTINGENCY THEORIES OF TECHNOLOGY.

Modern contingency theorists claim that the structure of organizations should vary, depending upon factors like the technology of the organization (Arnold & Feldman, 1986).

Contingency theories of technology have argued the following three propositions:

- i. The type of technology in the organization influences the type of organization structure that should be used. If the type of structure

fits the type of technology, the organization will be more successful.

- ii. Different departments and divisions of the organization use different technologies. Therefore, the structure of these sub-units should vary, depending upon the type of technology they employ. Not all sub-units have to be structured similarly.
- iii. Different types of coordination and control systems are appropriate for different types of technology.

Organizational technology moderates the relationship between organization design and organizational effectiveness. The fit between the type organization structure and the type of technology influences how effective the organization can be (Arnold & Feldman, 1986).

4.4 LABOUR-INTENSIVE VS CAPITAL-INTENSIVE TECHNIQUES IN PRODUCTION.

The question of how goods and services should be produced essentially involves choosing the best methods of production to produce the various goods and services. Frequently, various techniques are available to produce a specific object. For example a dam or a road may be built with large machines and relatively little labour, or it may be built with less sophisticated equipment and more labour. When machines dominate the

production process we talk about capital-intensive production. If, however the emphasis is on labour, the technique is labour-intensive.

The appropriate choice of technique will depend on the availability and quality of the various factors of production. For example, a rural African community which does not have access to capital goods such as tractors will usually have no option but to use unsophisticated equipment and a lot of physical effort to produce food.

According to Gerber et al. (1987) it is remarkable to see the wide variety of different kinds of technology found in South African organizations in the last decade of the 20th century. Underprivileged communities are still using “traditional” technology (such as agricultural techniques), while somewhat more modern technology is used in the middle groups of societies for example in the small business sector, informal sector.

In both rural and urban areas we find a tendency towards labour-intensive industries rather than technology-intensive industries. “This can largely be ascribed to the fact that these people lack the skills to make optimal use of more modern technology, and do not have sufficient capital to obtain it. At the other end of the scale we find large modern industries that are characterized by technological intensity in practically every sphere of production and services” (Gerber et al., 1987, p. 565).

If the Republic of South Africa (RSA) wants to enter world-markets, high level world-technology has to be followed. If the RSA wants to maintain the conventional and the traditional technology in the industrialization process, the borders for imports has to be closed to develop an alternative lower-level technology which will not threaten large scale job-opportunities in the country. To the outside the RSA will primarily have to follow the international high-technology capital-intensive model. To the outside world the country will primarily have to follow a technology according to a labor-/demographical-intensive model (Human Resources Management, 1994).

The development of the three core-technologies of the information-revolution namely microelectronics, the computer and telecommunication are all depending on research and is development-intensive and thus capital-intensive. To make the investment profitable the country will have to aim for the world-market and not only for the local markets.

An outflow of the entering of world-markets is the economical tendency of internationalization of production and markets and the increasing importance of components-production in exports.

The viewpoint is that if South Africa can become more and more technologically competitive so that the country can keep up with global trends a wealth can be created through exports and as a result the country's local industries can be protected from imported goods and technology. This

enhances the chances of growth and job-opportunities. Large-scale protection will most probably be limited to the industries directed to the inside like the building industry and industries which are mainly labour-intensive (Human Resources Management, 1994).

4.5 NATURE OF HIGH, CONVENTIONAL AND APPLICABLE (TRADITIONAL, MAINTENANCE) TECHNOLOGY.

Conventional technology is aimed at improved effectiveness and specialization of knowledge/functions. It enables the producer to complete tasks quicker, more reliably and in greater volumes, “...while preserving the qualitative nature of flows, structure of the support net, skills, styles and culture. Technology allows us to do the same thing in essentially the same way, but better” (Human Resources Management, 1994, p.120).

Applicable technology (traditional and maintenance technology) “...preserves the support net as well as the flow through it.” The same things are done in the same way (Human Resources Management, 1994, p.120).

High technology “... changes the nature of tasks and their performance, interconnections and nature of physical energy and info flows, skills required, roles played, organizational culture. It allows (often requires) to do things differently and to do different things. Instead of machines further

enhancing division of labour and specialization of knowledge, high tech (computers, robots, telecommunications etc.) support a multi-functional worker, self service user, systems orientated/trained worker” (Cornish, 1985 in Human Resources Management, p.120).

The implementation of high technology is costly. It is costly in terms of equipment as well as training. To effectively implement high technology like information systems using computers, knowledge is important. The capital and knowledge needed to implement high technology is not always accessible for developing countries.

4.6 MAIN GROUPS OF GROWTH TECHNOLOGIES.

In general it is agreed that the greatest growth will take place in the following technologies:

- The information-technology with microelectronics, the computer, robotics and communications as elements.
- The biotechnology.
- The material-technology.
- The energy-technology as a possibility.

The first three is of such a magnitude that it can be seen as a technological revolution, which possess the potential to change the whole economic system and training.

The experience in Europe was that the microelectronics and computer technology concentrated on automation of the production processes during the late seventies and in the early eighties the phase of infra-structure-technology (especially market and office-technology) commenced. Another observation was that material-technology started strongly and that the advancement of biotechnology still lay ahead (Human Resources Management, 1994).

4.7 TECHNOLOGY AND SOUTH AFRICA.

South Africa has a dualistic nature in terms of development. Technological development can be placed on a continuum where South Africa is moving slowly from being traditionally an agricultural orientated country to becoming more and more industrialized. The more the movement is towards industrialization the more technical knowledge and training is needed in the country.

The faster Developed Countries implement and create new forms of technology the greater the gap between them and South Africa. A problem is however that the more automation takes place in different areas of

production the higher the unemployment rate will be in the country. Knowledge and training to use new systems takes time. Time which is already an important factor between Developed and Developing countries. The rate of growth and development in Developed countries is much faster than in Developing Countries. If the gap in growth and development were closer the decisions for implementing technology would not have been such a problem in Developing countries.

4.8 HUMAN FACTORS IN ORGANIZATIONAL DESIGN AND MANAGEMENT.

Historically, human factors have been concerned with the design of controls, displays, and workspace arrangements. In system design, the operations to be required of the system typically have been analyzed to identify the specific functions that comprise them.

At this point the human factor specialist enters the design and based on his or her professional knowledge of human performance capabilities and limitations, assists in allocating these functions to humans or machines.

“Technological change is change in processes, materials, machinery or equipment, which has an impact on the way work is performed in an enterprise or on the efficiency and effectiveness of the enterprise” (Gerber et al., 1987, p. 564).

Gerber et al. (1987) explains the definition further by stating that technological change should be aimed at building more successful organizations. Success is only possible by creating more efficient and effective organization. Gerber et al. (1987) states that change should never be brought about for its own sake, but only to increase productivity especially, when the consequences of technological change are taken into account.

4.9 CONCLUSION

Technology is designed by humans to be used by humans to enhance production. Human beings spend their working hours at the workstation and if it is not a comfortable zone for them maximum production will not be possible.

If organizations want to maintain maximum production it is important that the technology will fit the task as well as the person operating it. The capacity at which technology is functioning is dependent on the human beings that design and operate it.

The designer and the operator of technology are not necessarily the same person or group of persons or even from the same organization. The user has to understand the technology very well to use it efficiently. It is very

important that users of technology are properly trained to use it productively.

Technology users are from different cultures within organizations. The way in which different workers from different cultures perceive technology and understand technology may influence the efficiency of production.

Imported technology means that the designer of technology was from different cultural groups than the cultural group of the user. Successful and efficient use of technology becomes more and more dependent on the influence of the cultural factors of the users.

It is the purpose of this study to establish whether cultural diversity influences the application of technology.

In the following Chapter the role of ergonomics becomes clearer. It is to fit human to machine. Both man which originates from a certain culture and used within an organizational structure has to fit. The fit lies in the design of the technology. This places the role of ergonomics as one of linking culture and technology together to be a productive unit.

Chapter 5

CULTURE AND TECHNOLOGY

5.1 INTRODUCTION

“Technology is regarded both as part of the culture and its product” (Shahnavaz, 1994, p.365). More than 60 years ago (in 1931) technology was included in the Encyclopedia of the social sciences in Malinowsky, as part of culture and gave the following definition; “culture comprises inherited artifacts, goods, technical processes, ideas, habits and values” (Shahnavaz, 1994).

Culture is regarded as an important aspect in technology design, development and utilization. The relationship between culture and technology is complex and should be analyzed from several perspectives in order to be considered in the design and application of technology (Shahnavaz, 1994).

Technology is an essential part of culture. Acceptance and utilization of the technology by a society of different culture than the technology producer, involves much more than just possessing the hardware technology. (Shahnavaz, 1994) views that technical development via technology transfer

should not be an uncontrolled process and that it should be directed to meet the needs and aspirations of the native population.

It is essential for developing countries to obtain the technology that is most relevant to their environment at a particular point of time (Shahnavaz, 1985). The levels and type of technology chosen depend on the recipient country that will use it. A wide range of possibilities exists from more traditional technology to modern technology.

Shahnavaz (1985) believes that technology can have a significant impact on the recipient country, employment, regional development, socio-cultural values and environmental balance (i.e., pollution risks from industrial processes and environmental hazards of many kinds).

The negative effects of technology can be prevented with proper understanding and consideration of human problems involved. It is the combinations of human and material considerations that ultimately determine the success of technology transfer (Shahnavaz, 1985).

“Ergonomics is a useful tool in evaluating the application of the choice and implementation of new technology and can contribute to safe and productive transfer of technology” (Shahnavaz, 1985, p. (iv)).

Shahnavaz (1985) states that if products, facilities and services are meant for human use, it is important that they suit people who do use them. It is therefore important that the equipment and facilities must take account of human abilities and limitation, human size and human variations.

Development effort (technological as well as social) are made to serve the human, aiming to make living more efficient and comfortable, the designing should consider people, making them fit for human use (Shahnavaz, 1985).

5.2 THE NATURE OF KNOWLEDGE, SKILLS AND TECHNOLOGY IN DEVELOPING COUNTRIES VS DEVELOPED COUNTRIES.

The classification of countries in terms of the level of their economic development is done on the basis of the different economic, social, political and cultural characteristics (Shahnavaz, 1991).

The invention, utilization and creation of modern technology used during the beginning of the nineteenth century placed Western countries on an advanced level of development. Industrialization, with the use of technology and knowledge, caused increased growth, creation of markets and rapid development.

The slower adaptation and development of the developing or less developed countries placed them in a category of “Third World Countries” (Shahnavaz, 1991).

Six broad characteristics are common to Industrial Developing Countries (Shahnavaz, 1991):

- (a) Low level of living.
- (b) Low productivity.
- (c) High rates of population growth and dependency burdens.
- (d) High unemployment rate.
- (e) Dependence on agricultural production.
- (f) Dominance, dependence, and vulnerability in international relations.

Most of the above characteristics prevail in South Africa. This places the country in a dependent and vulnerable economic position and low international competitiveness.

5.3 TECHNOLOGY TRANSFER TO INDUSTRIAL DEVELOPING COUNTRIES.

The transfer of technologies to Industrial Developing countries usually have Western or Industrial Developed characteristics. The nature of technologies in Western countries e.g. American technologies are aiming at high

mechanization and high output. These countries will always try to expand their markets and striving towards increased production.

Basic human factors differ such as size of people, physical environment, physical capacities of technology users, organizational and cultural differences. According to Shahnavaaz (1991) technology that is unadapted was found to be inappropriate, harmful, hazardous and unsuccessful.

The blind transfer of technology to Industrial Developing countries has proved to be detrimental to the majority of people. "It has also been realized that technology copied or transplanted, disregarding the human needs and the environmental characteristics of the recipient countries is very often too costly in terms of human suffering and material losses....." (Shahnavaaz, 1991, p.71).

5.4 NEW AND IMPORTED TECHNOLOGY AND CULTURE.

The concept of social and economic consequences of transferred Western technologies to the Developing Countries have increasingly been emphasized as well as the important role of socio-cultural variables in development strategies for industrialization and social progress.

Shahnavaz (1991) characterizes the general argument behind this new ergonomical trend in four ways:

- a) The policy of technology transfer as a rapid and short way to industrialization has failed in many Industrial Developing Countries, i.e. low productivity associated with low machine utilization, low quality of products resulting in a low quality of products resulting in low economic output overall.
- b) Indiscriminate modern and complex technological choice has resulted in accidents such as at the Union Carbide plant, Bhopal, India or at the sulphur extraction plant at Mosul, Iraq.

According to Shahnavaz (1991) imported technology has led to poor working conditions, an unnecessarily high incidence of accidents and disease together with an increase in general dissatisfaction, mental stress and social-political tension.

- (c) Some of the enterprises in Industrial Developing Countries have started to realize and acknowledge the important role of human factors in their choice of transferred technology.

- (d) Market competition adds to the trend e.g. machine and tool manufacturing in Japan and Europe does not pay much attention to designing their products to fit the end user.

Agreement exists that ergonomics is the practical science of work for studying real work and taking necessary action. Agreement exist that there are huge gaps in taking necessary ergonomic action in workplaces in different sectors and countries.

According to Kogi (1994) the situation continues that very little is done in small-scale, informal and rural sectors. The gaps are greater in technology transfer to industrially developing countries.

Two specific gaps are identified namely: (a) The fact that recognition of ergonomic needs, particularly about organization of work is hampered except in a limited number of workplaces. (b) The observed lack of clear strategies in adapting new or transferred technologies to local conditions.

The result is that ergonomic problems in small workplaces are generally neglected and local work improvements, particularly in technology transfer, are rarely recognized as possible goals of job design.

Kogi (1994) proposes steps that can be taken to increase positive impacts. Three practical steps of local nature seem commonly needed:

- (a) to promote work improvement approaches, including training, which build on local practice;
- (b) to develop practical methods for identifying locally solutions in multiple aspects of work, content, environment and organization;
- (c) to provide support for participatory ergonomic action in various situations (Kogi, 1994).

It is important for any organization to realize what the reality of their situation is regarding technological competitiveness. It is only if the existing position of an organization can be evaluated that corrective measures can be taken to adapt to a new situation. If a need exist to increase production by improved productivity using newer technology the actions of Kogi, given above can provide guidelines in creating solutions.

One of the realities addressed in this study is that of the existence of cultural diversity in the workgroups of South Africa. Since the first democratic election in 1994 in South Africa, many changes touched human beings directly in the workplace. One of these changes was that of accepting one another in the workplace, which entails the acceptance of different races, ages, genders, ethnic groups, languages and many more factors, which are

culturally calibrated. To establish unity of human beings within a production unit is important. Previously certain race groups were divided in the workplace and socially. In a new dispensation these groups are combined in the workplace and otherwise. Development and growth is more possible through the understanding of cultures and differences between people together in the workplace.

5.5 SPECIFIC CULTURAL FACTORS INVOLVED IN THE USE OF NEW TECHNOLOGY OR THE TRANSFER OF TECHNOLOGY.

Many different cultural factors cause differences in the workforce of a company. The following cultural diversity factors are found most commonly in literature to have an influence in the workplace.

- i. **Anthropometry.** A difference in body sizes of different populations causes many products and machines imported from Industrialized countries not to fit the local populations. Previous laboratory studies done by the Human Science Laboratory have shown that the body dimensions of the Black South African male are in general significantly smaller than those of males of European origin (Chapanis, 1975).

The Ergotek Ergonomic Consultants did new research on anthropometry where differences between subgroups of cultural groups were found. This

information is available from the above consultants. An address is supplied in the reference list.

- ii. **Attitudes and prejudices.** Their cultural background influences people's attitudes towards work and working habits. Certain attitudes towards certain jobs considered to be degrading or a 'dirty hands' approach.

Employees exposed to bias, discrimination and stereotyping becomes vulnerable and influence the fit between talents/aspirations and organizational opportunities (Greenhaus & Callanan, 1994). Negative attitudes still exist against women and other minorities although unfair and unlawful.

- iii. **Values.** Western cultures value individualism, materialism and competitiveness, Asians emphasize the individual's duties towards his family and community whereas the "ubuntu" phenomenon is found amongst South African Blacks where collectivism and commitment to the group are regarded as important.
- iv. **Language and communication.** Both verbal and non-verbal behaviour and communication methods differ in meaning across cultures. This can lead to misunderstanding and result in different reactions from different people from diverse cultures.

“Cross-cultural communication difficulties go beyond language. They also include differences in nonverbal communication. For example, in appraisal interview and in work-group meetings, foreign-born employees may not openly communicate their perceptions and ideas” (Sherman et al., 1996, p.556). They may be reluctant to express their thoughts for fear of showing their limited language skills. It may be that their culture taught them to respect authority even when they believe that the authority may be wrong (Sherman et al., 1996).

Davies in Shahnavaaz (1985) states the importance of the designing of good manuals and instructions is important. The technical vocabulary in many developing countries is limited. Translations are often poor at conveying meaningful understanding.

Communication problems that come from managing a multicultural and diverse workforce require the attentions of management (Sherman et al., 1996).

- v. **Ethnicity**, is regarded by Mukulika (1999) as a system of people who consider themselves or are considered by others to share common characteristics that are different from the other people in any society. Ethnicity based on the Greek term ‘ethnos’ is frequently distinguished from race, although ethnic groups may share racial characteristics.

Different ethnic groups may exist within the same race. Attachment to ethnicity, as distinct from attachment to race may arise in different ways: Firstly, culturally patterned forms of behaviour by which individuals satisfy their needs may bring them closer to some people rather than other. Secondly, the similarities between members of an ethnic group may be based on physical characteristics as much as cultural characteristics, to create a “consciousness of kind”. Thirdly, similarity of cultural behaviour may be seen as a sign of cultural relatedness (Mukulika, 1999).

Where different ethnic groups gather within one workgroup these different approaches can lead to conflict and misunderstanding.

- vi. **Time perspective.** Traditional Africa has a cyclic time perception and value is being granted to the past and lessor attention is been given to the future. Time is made up by experiences and because the future did not yet happen, lesser attention is been given to it. According to Oosthuizen in Leistner the African traditional man is orientated in accordance with the past (Leistner, 1989).

The more different cultural groups come into contact with one another the more likely their value systems and attitudes might change. An aspect, which is considered, is whether certain groups expect other groups to adapt to themselves or whether certain groups easily adapt to other groups or whether groups or persons will change at all.

- vii. Educational Background.** Differences of education systems cause different levels of outcomes. In South Africa the idea of people's education has grown up in reaction to the discriminatory Bantu education system.

Projects including literacy work support for matriculation students and help for children and adults i.e. ABET, started to address the problems related with inequalities of the previous education system in South Africa. More emphasis has been placed on 'empowerment' in terms of education.

Education systems do not change overnight. The needs for further development of literacy and adult education are very clear (Graham-Brown, 1991).

In this study an attempt is made to establish whether different education levels do cause a delay or have an influence on the mastering of technology.

- viii. Religious beliefs.** So many different beliefs and specific religious beliefs exist in South Africa. Many people with different beliefs and religion gather in the workplace. Differences are obvious in the South African society. People belong to Christian, Moslem, Jewish, Buddhist and many

more religious groups. Traditional beliefs differ and some are based on the supernatural e.g. forefathers, witchdoctors, and many more.

These beliefs and religion are formed within people since birth. It forms their personality and has an influence on their sense of belonging. People gathering in the workplace originate out of an array of beliefs and religion. The possibility that these differences can have an influence is considered in this study.

5.6 SPECIFIC EXTERNAL VARIABLES WHICH INFLUENCES THE TRANSFER OF TECHNOLOGY.

The following external variables have been identified as important elements, which can influence the implementation of technology although differences do exist because of cultural factors. These factors are not part of cultural difference but factors, which if applied efficiently can solve some problems, related to cultural differences:

- i. **Training.** The nature of training received and the significance of training in the process of mastering technology is considered. Further training needs may be possible to establish if a deviation to the expected knowledge of the technology in use can be indicated.

- ii. **Imported technology.** When importing technology it possible that it is not yet technically calibrated to suit the organization. If not, the task expected of a worker cannot be performed. Certain countries from where technology originate, may have a population of which body size differ considerably from the users in South Africa that may have an influence on the success of the use of the technology.

The instruction manuals and physical instruction on the technologies may be in languages not known by the users in South Africa. This aspect makes training and the use of the technology very difficult and mastering may be prolonged.

- iii. **Management.** The manner in which management approach cultural differences within the organization as well as consider it when importing technology can have an important effect on successful implementation of technology.

If it is known which cultural diversity factors can have an influence on the application of ergonomics and the transfer of technology, control can be exercised over these factors by management through implementing plans or programs of action.

5.7 ERGONOMICS AS THE LINK BETWEEN CULTURE AND TECHNOLOGY.

Cultural diversity forms part of the existence of humans, and their total being is a combination of past experiences. Human beings also operate technology. It is therefore important that harmony should be established between man together with his cultural attributes – physiologically and psychologically - and technology.

Ergonomics is a method of creating harmony between technology and human resources. According to Shahnava (1991) technology implies various types of machinery and different tasks to be performed. It depends on which technology is chosen which psychological and physiological demands are created, and which must be fulfilled by the available personnel.

The application of ergonomics makes it possible to link and fit the technology to the working force of the production process and thereby create an optimum productive operating situation.

5.8 CONCLUSION

In Chapters two, three and four the elements present in the physical working situation was discussed namely Ergonomics, Culture and Technology. In Chapter five culture and technology were combined to indicate the influence

of the one on the other. This leads then to the hypothesis that cultural diversity influences the implementation of technology.

In the following chapter this hypothesis will be empirically tested by of a questionnaire adapted from Gardenswartz & Rowe (1998), & Kishashu (1997) and Vos (1998).

Gardenswartz & Rowe (1998) see diversity as an arena which, is rapidly changing and evolving. The areas of focus continue to shift. What doesn't change is the need to address the issues. A culture of inclusion, demographic trends, globalization, competitive marketplaces and the need for top talent all point to the fact that regardless diversity does matter in a highly complex and competitive world.

The survey done by Kishashu, (1997) from the University of Lulea, was valuable in the way in which he gathered data concerning the influence of human factors in the absorptive capacity of technology transfer in Tanzania.

Not much previous research was found where cultural diversity factors were measured against the success of the implementation of technology.

The purpose of the empirical measurement will be to indicate reasons for the influence of specific cultural diversity factors on the implementation of technology.

CHAPTER 6

RESEARCH METHODOLOGY

6.1 INTRODUCTION

In the previous chapter, specific cultural diversity factors as well as specific external variables have been selected that will be used as the independent variables in this study.

From the hypothesis that cultural factors influence the implementation of ergonomics in developing countries with specific reference to the transfer of technology, the most important concepts interacting in this study are culture, technology and the link between them namely ergonomics. An attempt was made in the previous chapters to explain the meanings of these concepts to reach emphasis of this study.

The emphasis of this study is to determine the influence of selected cultural diversity factors on the use of technology, which has a direct influence on the implementation of ergonomics.

The purpose is to test the hypotheses that cultural diversity factors influence the implementation of ergonomics in developing countries with specific reference to the transfer of technology.

In this chapter the measuring instrument used to measure the reasons for certain cultural factors to have an influence on the use of technology and the impact thereof on ergonomics will be discussed.

A survey was designed on the basis of previous studies done by Gardenswartz & Rowe (1998), Kishashu (1997) and Vos (1998) which is related to the topic of this study.

Objectives set for this study are as follow:

- (a) To determine the influence of specific cultural factors on the application of ergonomics, within a developing country;
- (b) To determine the influence of specific cultural factors on the transfer of technology within a developing country.

Hypothesis set for this study:

Cultural factors influence the implementation of ergonomics with specific reference to the transfer of technology in developing countries.

The research area for this study is Eastern Mpumalanga. Mpumalanga is one of nine provinces within South Africa. The research cannot be conducted over the whole of South Africa and thus the population was taken from only a portion of the country.

6.2 METHODOLOGY IN THE DESIGN OF THE SURVEY

The dependent variable as indicated by the hypothesis is the successful implementation of ergonomics with specific emphasis to the transfer of technology within a specific area of research being Eastern Mpumalanga, South Africa.

A survey on cultural diversity and the impact thereof on the use of technology are adapted from;

- (1) work done and guidelines given on diversity by Gardenswartz & Rowe (1998);
- (2) the survey done by Kishashu (1977) on the influence of human factors in absorptive capacity of technology transfer; and
- (3) the study done by Vos (1998) on the diversity phenomenon amongst managers in selected organizations.

Firstly, questions was formulated based on some of the guidelines given by Gardenswartz & Rowe, (1998) diversity consultants/trainers based in Los Angeles, and authors of several books on diversity.

To measure diversity they proposed companies to use the following questions listed below:

- In how many countries does your organization operate?

- How many languages are spoken by your customers/clients?
- How much does employee turnover cost your organization?
- How much have discrimination/harassment suits cost your organization in the past year (in both legal fees and settlements)?
- What are the demographics of your customer/client base? (E.g., age, income, gender, education, ethnicity, etc.)
- How frequently does inter-group conflict sap productivity?
- Is there higher level of turnover among certain employee groups?
- Are your policies and benefits attractive to potential recruits?
- Is your organization losing top talent because people do not feel heard, included or valued?
- Do employees feel that their skills and talents are well rewarded?
- Is there some career advancement possibility for employees and a focus on developing people internally?

Not all questions were applied but appropriate questions were mostly rephrased for this study.

Secondly, the survey done by Kishashu (1997) in Tanzania was valuable in that it was a specific Ergonomics study done on human factors and the transfer of technology which could have a direct impact on this study in South Africa.

Thirdly Vos (1998) did an industrial psychological study of the diversity phenomenon amongst managers in selected organizations. In his study Vos (1998) made use of The Cultural Diversity Belief scales, which are value scales to determine the valuing of cultural diversity as a behavioural construct. The value scales used by Vos (1998) are useful in the understanding of the belief and value of diversity of management. The scale used by Vos (1998) was not used but adapted as a tool in the construction of the survey for this study.

The survey on cultural diversity and the impact thereof on the use of technology in (Appendix B), is designed to isolate certain cultural factors as independent variables.

6.3 CLASSIFIED SELECTED INDEPENDENT VARIABLES.

The independent variables were selected on basis of the literature used and guidelines on diversity by Gardenswartz & Rowe (1998), and surveys done by Kishashu (1977) and Vos (1998). Many other variables exist but only the most general cultural factors used in the literature were included in this study namely: language/communication, religious beliefs, anthropometrics, educational background, time, ethnicity values, attitude, and values.

The survey is titled: “Survey on Cultural Diversity and the Impact thereof on the use of Technology”. It consists of five sections namely:

- A. Demographics
- B. Extent of cultural diversity.
- C. Extent of use of technology.
- D. Management of cultural diversity with regards to the implementation of technology.
- E. How much is cultural diversity valued in your company?

The following definitions of the terms cultural diversity, technology and imported technology was provided:

Cultural Diversity: Reflect on any differences that exist between groups of people on basis of any of the following factors, race, ethnicity, language, rituals, religious preferences, beliefs, values and attitude.

Technology: The use of any tools of mechanical or informative nature e.g. computer systems or any workstation where handling of controls are needed in the execution of tasks.

Imported Technology: The use of any technology imported from another country.

The respondents were requested to indicate their opinions to the following options: Strongly agree, Agree, Neutral, Disagree, Strongly disagree and Unable to answer.

6.3.1 DEMOGRAPHIC INFORMATION

The following demographic information is relevant for this study.

- (a) The management levels of respondents. A summary of the results reveal that 56 % of the respondents is on Senior Management Level and above to Chief Executive Level and 44 % at least on First Line Supervisory level up to Middle Management Level.
- (b) Experience of the respondents. 61 % of the managers have more than 6 years experience. Not one respondent had less than 2 years experience in their positions.
- (c) Size of the organization. More than half of the respondents worked for organizations with more than 501 employees, making the information gathered valuable and widely applicable.
- (d) The age group of respondents. The larger proportion of respondents was older than 31 years and three of the respondents are younger than 30 years old.
- (e) Educational qualification. All of the respondents completed secondary school and 55 % has either a College or a Technicon diploma. A third of the respondents has postgraduate qualifications.

- (f) Sector in which employed. The majority, 72 % of respondents is currently employed in the private sector. The remaining 28 % are in the public sector.
- (g) Main operation of the organization. The following sectors is represented namely:
- Manufacturing - 50 %
 - Construction - 20%
 - Information Technology – 20 %
 - Engineering – 10 %

It can be seen that these organizations are all concerned with technology.

6.3.2 CLASSIFICATION OF VARIABLES.

The following classification in (Table 1) represents the independent variables, which were selected. With each independent variable questions were labeled which would determine the responses to one or more independent variables.

TABLE 1: CLASSIFICATION OF SELECTED INDEPENDENT VARIABLES USING LABELS

Independent Variables	Labels
1. Language/Communication	B3, B4, B6, B9, C5, C6, C7, C10, C11, C12, C24, E1, E7, E18
2. Religious Beliefs	B3, B12, B14, B15
3. Anthropometrics	C18, C19, C20, C21, C28, C29, C30
4. Educational Background	B3, C25, E8
5. Time	B7, C26, and D12
6. Ethnicity Values	B3, B5, B12, B17, B18, E6, E7, E11
7. Attitude	B2,B7,B8,B10,B11,B13, C14, C22, C27, D1, D3, D4, D5, D9, D11, E3, E9, E10, E12, E13, E14, E15, E16, E17, E20
8. Values	B2, E2, E3, E5, E10, E16, E19, E21

Independent Variables (External Variables)	Labels (continued)
9. Training	C6, C7, C10, C11, C12, C23, C24, C25, D2, D8, E7, E18
10. Imported Technology	C8, C9, C15, C16, C18, C19,C23
11. Management	D1, D2, D3, D4, D5, D6, D7, D9, D10, D11, D12, E19

A total of eighty questions were set. Rephrasing questions or parallel questions constantly control each independent variable or cultural factor to provide validity to responses. Rephrased or parallel questions recurred in any of the five sections.

6.4 PARTICIPANTS IN THIS SURVEY

This study was conducted within the Eastern part of Mpumalanga, a province in South Africa. The questionnaire was presented to managers or supervisors only.

Twenty questionnaires were handed out. Eighteen management respondents from seven companies completed the survey. The companies were chosen at random in the Eastern Mpumalanga area. The questionnaires were personally handed to managers. Identified persons were instructed to sort the input of colleague's after which the questionnaires was then handed back to managers. The questionnaires were then personally collected from the individual managers.

This is obviously a small number to use in research such as this however the explorative nature of this study as well as the fact that the one executive responding represented the situation of the whole organization compensated for it. Although the numbers of respondents were relatively low each represents a larger group. The candidates within a company are the same and would probably be perceived the same if many more respondents were used in each company.

Main operations of participation companies were in manufacturing, construction, information technology and engineering. The companies chosen all use technology and have diverse workgroups.

The purpose of this study is not so much statistical proof as it is identifying contributing factors to the implementation of ergonomics in the technological area.

6.5 CONCLUSION

In this chapter the strategy used when designing a survey to determine the causes for certain cultural factors to have an influence on the application of ergonomics and the transfer of technology in a developing country South Africa within the Eastern Mpumalanga is discussed. The following factors were used as independent variables: Language/communication, Religious Beliefs, Anthropometrics, Educational Background, Time, Ethnicity Values, Attitude, Values, and Training, Imported Technology, and Management as external independent variables.

In Chapter 7 the results of the survey completed by different companies in Eastern Mpumalanga is presented.

CHAPTER 7

RESULTS

7.1 INTRODUCTION

The design of the measuring instrument and the methodology followed in the empirical part of this study was discussed in Chapter 6.

It is important to emphasize that although the results obtained refer to the Eastern Mpumalanga area, the objectives set for this study is a global phenomenon. It has bearing for this area researched in this study as well as workplaces over the whole of South Africa and all over the world.

South Africa has a diverse population, which consist of different races, religions, gender, language groups, educational backgrounds, ethnic backgrounds and different training needs.

The extent of the influence of selected cultural differences in the work force of organizations will be reflected in the results from the empirical study done using the survey in the described area.

7.2 RESULTS

The specific results for each variable is discussed individually. Using frequency distributions per variable (Appendix C) the results for the specific factors identified for this study will be discussed.

Values allocated for evaluation is as follows: Unable to answer (0), Strongly disagree (1), Disagree (2), Neutral (3), Agree (4) and Strongly agree (5).

The applicable labels were combined to control specific variables. Although responses for the different questions were combined using labeling, the population remains 18. The two surveys, which were not returned, were not taken into account.

The sample of 18 is regarded as small and is a limitation of this study. Measuring instruments used: A frequency distribution and although the line of reasoning is the same as for large samples a distribution of t is used instead of the normal distribution in fixing the limits of the interval.

The probability criterion is set at 0,05 and used throughout for all variables.

i. Language/Communication.

The frequency distribution for language/communication is presented in Appendix C.

Mean: 3,079 $t = 1,839$

Standard deviation: 1,337 $df = 17$

Variance: 1,787

Level of significance:

Using a frequency distribution: The high mean, standard deviation and variance points to a high value obtained by these responses. The high standard deviation and variance also points to the fact that most responses are spread around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

58 % of the responses supports the hypotheses that the diversity factor of language/communication influences the implementation of technology significantly.

Using a t-test:

- for a one-tailed test the null hypothesis is rejected at a probability of 0,05.
- therefore: the empirical hypothesis is confirmed that language/communication influences the implementation of ergonomics.

Conclusion: Both a frequency distribution and a t-distribution support the hypothesis that language/communication influences the implementation of ergonomics with specific reference to the transfer of technology.

ii. Religious Beliefs.

The frequency distribution for religious beliefs is presented in Appendix C.

Mean: 2,653 $t = 0,514$

Standard deviation: 1,260 $df = 17$

Variance: 1,588

Level of significance:

Using a frequency distribution: According to the responses the mean of 2,654 is not much higher than the average of 2,5. The responses above and beneath the average was nearly equal meaning that as many responses agreed as disagreed that religious beliefs influence the implementation of technology.

The standard deviation and variance is high, pointing to the fact that most responses are spread around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

According to the frequency distribution religious beliefs do influence the Implementation of technology to a certain degree but is not a significant determinant.

Using a t-test:

- using a two-tailed test the null hypothesis is accepted at a probability of 0,05.
- Interval estimates: $-0,514 \leq 2,5 \leq \bar{X} \leq + 0,514$
- the hypothesis is not rejected with the acceptance of a null hypothesis.

Conclusion: Both the frequency distribution as well as the t-distribution fail to significantly support the hypothesis that religious beliefs influence ergonomics, however it is important to remember that the population was very small. It is possible that for a larger population (N), religious beliefs might have a greater influence on the implementation of ergonomics. On the basis of a mean of 2,653 it is not possible to reject the hypothesis.

In South African many different religious beliefs exist. It may not be so easy to observe the influence of religious beliefs in South Africa as it is the case in Northern Ireland where Protestants and Catholics are in constant conflict, which causes disruption.

Thus the hypothesis that religious beliefs has an influence on ergonomics with specific reference to the transfer of technology is accepted on the basis of the reasons given above.

iii. Anthropometrics

The frequency distribution for anthropometrics is presented in Appendix C.

Mean: 2.881 t = 1,254

Standard Deviation: 1,289 df = 17

Variance: 1,660

Level of significance:

Using a frequency distribution: More than 50 % of responses agreed that anthropometrics have an influence on the implementation of technology.

This high score is an indication that this factor should be taken into consideration when implementing technology.

Homogeneity: the high values of the standard deviation and variance indicate that a variety of answers were obtained and answers were not homogeneous.

With more than 50 % positive responses that anthropometrics as a factor of cultural diversity influences ergonomics with specific reference to the transfer of technology and a high mean of 2,881 the hypothesis is accepted using a frequency distribution.

Using a t-test:

- for a two-tailed test the null hypothesis is accepted at a probability of 0.05.
- Interval estimates: $-1,254 \leq 2.5 \leq \bar{X} \leq + 1,254$
- The hypothesis is not rejected although a null hypothesis is accepted.

Conclusion: Although the null hypothesis is accepted using a t-test it is not possible to reject the hypothesis that anthropometrics influence ergonomics with specific reference to the transfer of technology.

The results using a frequency distribution indicate that more than 50 % support the hypothesis. It is also possible that for a larger population (N), more support would be found for this variable anthropometrics.

Previous studies done by the Human Science Laboratory that body dimensions of Black and European males differ (Chapanis, 1975) and new research on anthropometry by Ergotek Ergonomic Consultants, that differences exist between subgroups of cultural groups indicates anthropometrics does have an influence on workgroups.

Thus the hypothesis that anthropometrics as a cultural factor influence ergonomics with specific reference to the transfer of technology is accepted.

iv. Educational Background.

The frequency distribution for educational background is presented in Appendix C.

Mean: 3,556 t = 3,792

Standard deviation: 1,181 df = 17

Variance: 1,395

Level of significance:

Using a frequency distribution: The mean of 3,556 represents a significant deviation from the average. The majority of responses 68,52 % agree that educational background influences the implementation of technology.

Homogeneity: the high values of the standard deviation and variance indicate that a variety of answers were obtained and that answers were not homogeneous.

From the frequency distribution the following: Educational Background influences the implementation of technology.

Using a t-test:

- for a two-tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $- 3,792 \leq 2,5 \leq \bar{X} \leq + 3,792$
- The empirical hypothesis is accepted that educational background as a cultural diversity factor influences the implementation of ergonomics.

Conclusion: Educational background is proved both statistically using a frequency distribution and a t-test, to have an influence on the implementation of ergonomics. Literature studies by Graham-Brown, (1991) indicated the need for further literature and adult education. Given a larger population (N) the influence of educational background would prove even greater.

The hypothesis is accepted that the cultural factor educational background influence the implementation of ergonomics with specific reference to the transfer of technology.

v. Time

The frequency distribution for time is presented in Appendix C.

Mean: 3.926 $t = 5,957$

Standard deviation: 1,016 $df = 17$

Variance: 1,032

Level of significance:

Using a frequency distribution: The high mean, standard deviation and variance points to a high value obtained by these responses. A majority of responses of 60,87 % agreed that time is a determining factor in the implementation of technology.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: Time as a cultural diversity factor influences the implementation of ergonomics with specific reference to the transfer of technology.

Using a t-test:

- using a two-tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $-5,957 \leq 2,5 \leq \bar{X} \leq + 5,957$
- The empirical hypothesis is accepted that time as a cultural diversity factor influences the implementation of ergonomics.

Conclusion: The results from both the frequency distribution and the t-test indicate that time has a significant influence on the implementation of ergonomics with specific reference to the transfer of technology. These findings are supported by literary studies done previously.

Oosthuizen in Leistner (1989) found that the African traditional man is orientated toward the past not the future. In production it is not possible to deal with the past. Production takes place from one moment to the other. Lost time is lost production. From the survey responses it is clear that time is an issue of importance when it comes to production.

Thus: The hypothesis is accepted, that time influence the implementation of ergonomics with specific reference to the transfer of technology.

vi. Ethnicity values.

The frequency distribution for ethnicity values is presented in Appendix C.

Mean: 2,910 $t = 1,468$

Standard deviation: 1,184 $df = 17$

Variance: 1,402

Level of significance:

Using a frequency distribution: The values for ethnicity correspond with those of for the factor of religious beliefs as well as for antropometrics. The mean of 2,910 implicates that more than 50 % agree that ethnicity influence the implementation of technology however only little less than 50 % disagree. If looking closer at the value responses it becomes clear that 15,97 % remained neutral when answering questions on ethnicity. If subtracting the neutral responses from those who agree only 37,5 % remain.

The standard deviation and variance is high pointing to the fact that most responses are spread around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: According to the responses received to this study, ethnicity values, as a cultural diversity factor does not significantly influence the implementation of technology.

Using a t-test:

- using a two-tailed test the null hypothesis is accepted at a probability of 0,05.
- Interval estimates: $-1,468 \leq 2,5 \leq \bar{X} \leq + 1,468$
- The hypothesis that ethnicity influences ergonomics is not rejected.

Conclusion: According to both the frequency distribution and the t-test, ethnicity as a cultural factor does not significantly influence the implementation of ergonomics. However it is important to remember that this survey was done in a very narrow area in the country. If this survey is done in other areas with a larger population (N), it may change the outcome.

Historically in the South African gold mines ethnic conflict happened regularly. Ethnic groups had violent fights, which disrupted production from time to time.

Therefore, the hypothesis that ethnicity values influence the implementation of ergonomics with specific reference to the transfer of technology is not rejected.

vii. Attitudes.

The frequency distribution for attitude is presented in Appendix C.

Mean: 3.256 $t = 2,822$

Standard deviation: 1,137 $df = 17$

Variance: 1,293

Level of significance:

Using a frequency distribution: The majority responses support the influence of attitude towards technology for the implementation of technology. Only 34,4 % disagreed and 53,21% agreed. Only 12,39 % remained neutral.

The high mean, standard deviation and variance points to a high value obtained by these responses. The high standard deviation and variance also points to the fact that most responses are spread around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: The frequency distribution for attitude as a cultural diversity factor indicates that a significant majority supports the hypothesis that the attitude of workers towards technology influences the implementation of technology.

Using a t-test:

- for a two-tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $-2,822 \leq 2,5 \leq \bar{X} \leq + 2,822$
- therefore: the empirical hypothesis is accepted that attitude as a cultural diversity factor influences the implementation of ergonomics.

Conclusion: From the responses the outcomes clearly show that attitude significantly influence the implementation of ergonomics with specific reference to the transfer of technology.

Literature studies showed that differences exist in attitudes towards work and work habits. Certain kinds of jobs are regarded with a 'dirty hands' approach. Discrimination against women and other minorities such as disabled persons in the workplace causes stress. In South Africa much is said about discrimination against women and for instance racism however it is still present in many organizations.

The hypothesis that values influence the implementation of ergonomics with specific referent to the transfer of technology is therefor accepted.

viii. Values

The frequency distribution for values is presented in Appendix C.

Mean: 3.063 $t = 2,220$

Standard deviation: 1,075 $df = 17$

Variance: 1,156

Level of significance:

Using a frequency distribution: The high mean, standard deviation and variance points to a high value obtained by these responses. Most responses are spread around the mean as indicated by the high standard deviation and variance.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: Value as a cultural diversity factor influences the implementation of technology.

Using a t-test:

- for a two tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $- 2,220 \leq 2,5 \leq \bar{X} \leq + 2,220$

- therefore: the empirical hypothesis is accepted that values as a cultural diversity factor influence the implementation of ergonomics.

Conclusion: Studies and research done by many indicated that between Western, Eastern and African communities different value systems exist.

On the basis of the statistical data and the research done on differences in value systems the hypothesis is accepted that values influence ergonomics with specific reference to the transfer of technology.

ix. Training.

The frequency distribution for training is presented in Appendix C.

Mean: 3,308 $t = 2,711$

Standard deviation: 1,264 $df = 17$

Variance: 1,598

Level of significance:

Using a frequency distribution: The mean of 3,308 represents a significant deviation from the average. The majority of responses, 65,81 % consider training to influence the implementation of technology. The value of training corresponds with that of educational background where a majority of 68,52 % agree that educational background influence the implementation of technology.

The high standard deviation and variance points to the fact that most responses are spread around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers are obtained and that answers were not homogeneous.

Conclusion: Training as an external factor influences the implementation of technology.

Using a t-test:

- for a two-tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $- 2,711 \leq 2,5 \leq \bar{X} \leq + 2,711$
- therefore: the empirical hypothesis is accepted that training as an external factor influence the implementation of ergonomics.

Conclusion: The hypothesis that training influences the implementation of ergonomics with specific reference to technology is accepted.

Training is regarded as an external factor, which influence the implementation of ergonomics and the transfer of technology.

Training is a main area of concern and is of the utmost importance. If individuals are trained correctly and effectively it will lead to a better working environment for all people concerned with the enterprise. If training is available for all levels within an enterprise then the problem is being dealt with generally (Shahnavaz, 1991).

According to Lasserre (1982) in Shahnavaz, (1991) the orientation in training should be towards: cultural **skills**, which include language training, socio-cultural training, **managerial skills** and **technical skills**.

x. **Imported Technology**

The frequency distribution for imported technology is presented in Appendix C.

Mean: 3,000 t = 1,557

Standard deviation: 1,363 df = 17

Variance: 1,857

Level of significance:

Using a frequency distribution: The high mean, standard deviation and variance points to a high value obtained by these responses. The high standard deviation and variance points to an even distribution around the mean.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: The frequency distribution for imported technology indicates that 63,5 % supports that imported technology, as an external factor influences the implementation of technology.

Using a t-test:

- for a two-tailed test the null hypothesis is accepted for a probability of 0,05.
- Interval estimates: $- 1,577 \leq 2,5 \leq \bar{X} \leq + 1,557$
- Although the null hypothesis is accepted, imported technology as an external factor that can influence the implementation of ergonomics is not rejected.

Conclusion: Technology becomes increasingly complex, and ergonomic considerations are emphasized more and more in order to eliminate the possible negative effects. The majority of technologies transferred to Industrial Developing Countries are perhaps relatively simple; many cases have justified the value of ergonomic principles in these activities (Shahnavaz, 1991).

“Through considering the needs and requirements of a country from the ergonomics perspective prior to the transfer of technology, this transfer can be made a more effective and suitable tool for the economic development of that country” (Shahnavaz, 1991, p.57).

Based on the frequency distribution and t-test and the literacy studies as well as consideration to the small population (N), the hypothesis is accepted that imported technology as an external factor influence the implementation of ergonomics with specific reference to the transfer of technology. Using a larger population (N) in a larger area in South Africa is expected that imported technology will have a larger impact on the implementation of ergonomics.

xi. Management

The frequency distribution for management is presented in Appendix C.

Mean: 3.347 t = 3.270

Standard deviation: 1,099 df = 17

Variance: 1,208

Level of significance:

Using a frequency distribution: The high mean, standard deviation and variance points to a high value obtained by these responses. A majority of responses of 71,76 % indicated management as a factor that influences the implementation of technology.

Homogeneity: the high values of the standard deviation and the variance indicate that a variety of answers were obtained and that answers were not homogeneous.

Conclusion: Management as an external factor influences the implementation of technology.

Using a t-test:

- for a two-tailed test the null hypothesis is rejected at a probability of 0,05.
- Interval estimates: $- 3,270 \leq 2,5 \leq \bar{X} \leq + 3.270$
- therefore: the conclusion that management as an external factor influences the implementation of ergonomics is confirmed.

Conclusion: “Managerial training in communication and cultural differences is needed in all types of organizations” (Sherman, 1996).

The success of any organization is in the hands of its management. To be effective management has to consider all levels of employees and their needs and their aspirations as well as the holistic objectives of the company, which includes technology.

The frequency distribution and the t-test supports this view by indicating a high level significance of management in the implementation of ergonomics.

The hypothesis that management as an external factor influence the implementation of ergonomics with specific reference to the transfer of technology is therefore, accepted.

7.3 CONCLUSION

The following conclusions are inferred from the results:

- i. That specific cultural factors (language/communication, religious beliefs, anthropometrics, educational background, time, ethnicity values, and attitudes) as indicated by this study was found to have an influence on the application of technology.
- ii. Based on the results of this study the individual means were compared and an order of relevance can be given to the cultural diversity factors:

From highest scores to the lowest (excluding external factors):

- (1) Time
- (2) Educational Background

- (3) Attitude
- (4) Language/communication
- (5) Values
- (6) Ethnicity values
- (7) Anthropometrics
- (8) Religious Beliefs

- iii. External factors namely Management, Training and Imported Technology had significant high scores (3,00 and more) which implies that the role of these external variables are to be strongly taken into consideration when implementing technology. In all cases the hypothesis, that these external factors influence the implementation of ergonomics were accepted.
- iv. The application of ergonomics is affected by the influence of cultural diversity factors on the implementation of technology. Each individual cultural factor was statistical evaluated and supported by discussions and accepted as influencing the implementation of ergonomics with specific reference to the transfer of technology.
- v. That the hypothesis is accepted that specific cultural factors influences the application of ergonomics with specific reference to the transfer of technology in Eastern Mpumalanga a province of South Africa.

- vi. The following generalization is made on the basis of the above: Cultural factors influence the implementation of Ergonomics with specific reference to the transfer of technology in developing countries.

It is therefore accepted that if the hypothesis is true for the Eastern part of Mpumalanga, it will be true for the rest of South Africa and developing countries.

Shahnavaz (1991) states that there are various characteristics namely anthropometrical, physiological and labour force aspects, and socio-culturally which are already highlighted through ergonomics, that can be seen as causing fundamental differences between developed countries and developing countries. This can also be observed within populations of developing countries. If these factors are not considered in the design of jobs, workspace layouts, equipment, machines and tools for a particular population, it is likely to lead to health problems caused by forcible adaptation to bad working environment.

7.4 SUGGESTIONS FOR FURTHER RESEARCH

This study concluded that specific cultural diversity factors influence the application of ergonomics with specific reference to the transfer of technology in developing countries. Specific suggestions for further research:

- i. A comparative study of the influence of cultural diversity factors that influence ergonomics in other areas of the country or other countries.
- ii. A larger population(N), is advisable to make generalization more valuable
- iii. Identification of possible other cultural and or social factors which influence the application of ergonomics.
- iv. Managers of organizations completed the survey. Research amongst workers of organizations could make a valuable contribution.

Finally, it can be concluded that a mixed cultural workforce as found in South Africa should be taken seriously. The choice of technology and appropriateness thereof ultimately determines its success.

“The problem lies in the adaptation of technology to each society’s unique climatic, cultural and social characteristics and to its social goals” (Dy in Shahnavaaz, 1985, p.30).

Ergonomics plays a vital role in the facilitation of the process in understanding the human cultural factors that cause people to differ with the purpose of maximum integration with the physical environment.

A tailored integration or 'fit' between the human factors of the people of the countries concerned to technology would improve productivity, increase global competitiveness and accelerate development on a large scale.

It is on the basis of the cultural reasons for people to differ which had served the basis for this study. If understood, cultural diversity provides a much richer environment and different viewpoints, which can increase productivity through more effective use of technology.

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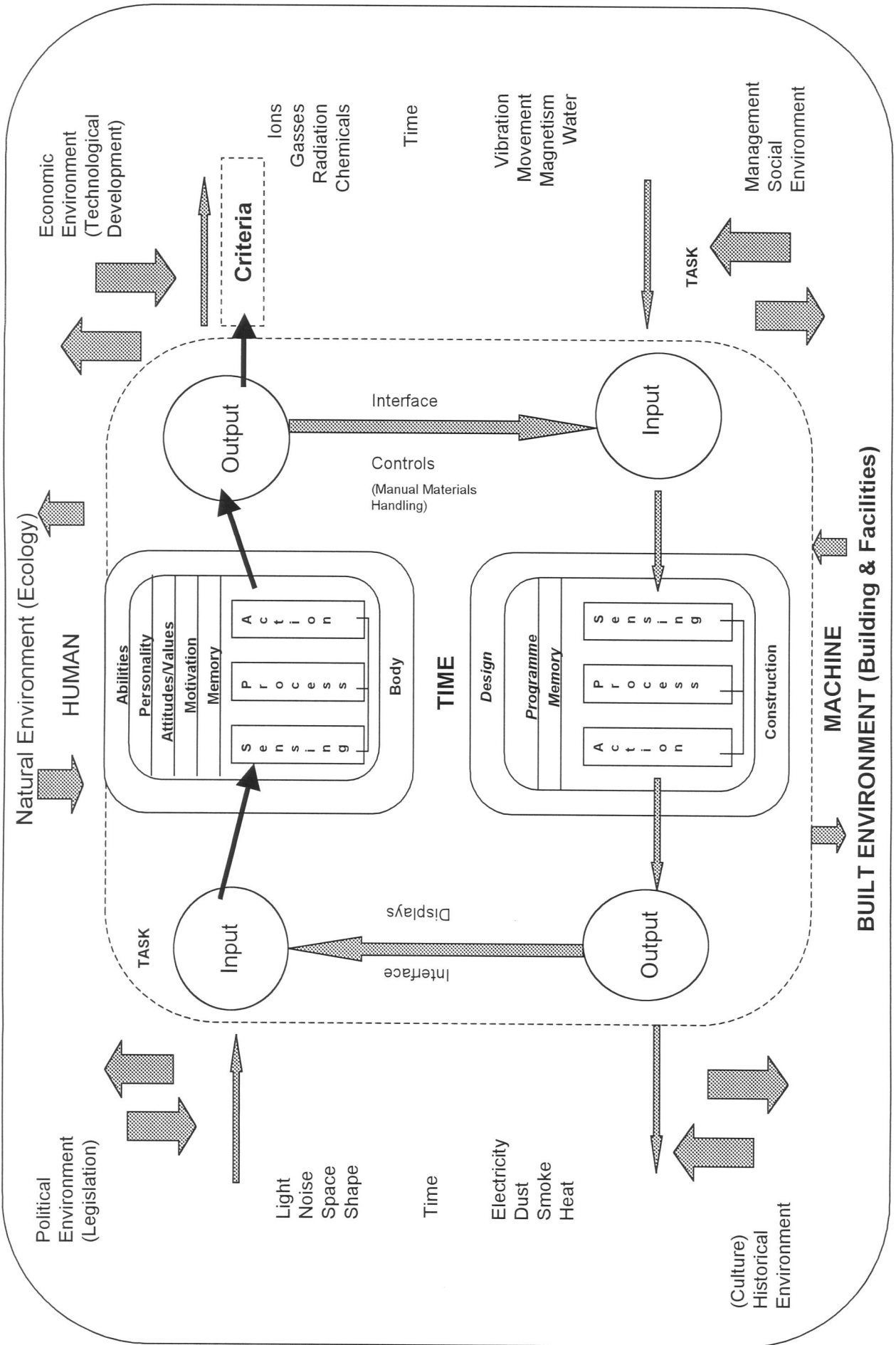
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**APPENDIX A: EXTENDED HUMAN-MACHINE SYSTEMS
MODEL - GRAPHICALLY ADAPTED FROM C J
CALITZ, (1997)**



**APPENDIX B: A SURVEY STUDY – MEASURING INSTRUMENT
USED IN THIS STUDY (DECREASED IN SIZE FOR
THIS PUBLICATION)**

SURVEY ON CULTURAL DIVERSITY AND THE IMPACT THEREOF ON THE USE OF TECHNOLOGY

Adapted from Gardenswartz & Rowe (1993), Kishashu (1997) and Vos (1998)

This survey is part of an Industrial Psychological study within the subject field of Ergonomics.

Technology is either purposefully designed or more often in South Africa like some other Developing countries, imported from Developed Countries. Cultural differences within the organization in a multi-cultural South-African situation as well as the influence of cultural differences between countries on technology are addressed. When implementing technology cultural differences are important especially in a multicultural society such as South Africa. This research investigates the various factors associated with the implementation of technology.

Please complete the survey and when completed I will personally collect it. All responses are anonymous – there are no right or wrong answers. Confidentiality is guaranteed.

I appreciate your participation in this study.

A - DEMOGRAPHICS

A1 **How long have you worked for your employer ? (Please tick one box)**

- Less than 1 year
- 2 - 5 years
- 6 - 10 years
- More than 10 years
- Self employed

A3 **Approximately how many employees does your organization have ?**

- Less than 10
- 10 - 50
- 51 - 100
- 101 - 500
- 501 - 1000
- More than 1000

A2 **Which industry describes your employer's main operation ?**

- Agriculture, forestry, fishing
- Mining
- Manufacturing
- Electricity, gas, water supply
- Construction
- Wholesale Trade
- Retail
- Hospitality, café's & restaurants
- Transport, Storage
- Communications
- Business services, property
- Government administration, defence
- Health, community services
- Cultural and recreational services
- Personal services

A4 **In what area do you mainly work ?**

- Distribution
- Engineering
- Finance / Accounting
- General management
- HRM / personnel
- Information Technology
- Marketing / Sales
- Office Administration
- Production / Operations
- Purchasing
- Research and Development / Design
- Training / Education
- Other

A5 **What is your age group ?**

Less than 25 years

25 - 30 years

31 - 40 years

41 - 50 years

51 - 60 years

More than 60 years

A7 **In which sector are you currently employed ?**

Private sector

Public sector - department

Public sector - government business enterprise

Public sector other (school, hospital)

Non profit organisation

A6 **What is your highest educational qualification ?**

Secondary education

College / Technicon diploma

University education

Postgraduate education

Other, please specify

A8 **What is the management level of your current position ?**

Chief Executive officer

Manager reporting to CEO

Senior manager

Middle manager

First line supervisor / manager

Other, please specify

Cultural Diversity.
 Reflect on any differences that exist between groups of people on basis of any of the following factors: race, ethnicity, language, rituals, religious preferences, beliefs, values and attitude.

Technology.
 The use of any tools of mechanical or informative nature e.g. computer systems or any workstation where handling of controls are needed in the execution of tasks.

Imported Technology
 The use of any technology imported from another country.

B. EXTENT OF CULTURAL DIVERSITY

Evaluate each of the following statements by ticking the box that best reflects your opinion of the specific statement. *(Please tick one box for each)*

The following according to my view exists in our organization:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
B1 Cultural diversity exists in the staff composition						
B2 People value and respect individual differences.						
B3 Cultural diversity is highly valued and equal employment opportunities are offered regardless of race, national origin, educational background, religion, sex age, ethnic group or language.						
B4 Complaints are made about staff speaking other languages at work.						
B5 Resistance exists to working with other groups, (regarding ethnic, gender, physical ability)						
B6 Difficulty in communicating due to limited or heavily accented foreign language.						
B7 Time has a different meaning to different cultural groups in the company.						
B8 Lack of social interaction between members of diverse groups.						
B9 Mistakes and productivity problems occur due to staff not understanding instructions.						
B10 Minorities within a group is normally ignored.						
B11 Frustrations result from cultural differences when using technology.						
B12 Employees should be allowed to observe their own religious and ethnic holidays in organizations that value cultural diversity.						
B13 Employees from diverse backgrounds feel comfortable working with each other.						
B14 The success of using technology are being hampered by certain religious beliefs.						

The following according to my view exists in our organization:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
B15 Certain religious beliefs distract the attention of the workers.						
B16 Different religious beliefs causes unrest among workers.						
B17 Certain ethnic groups tend to work better together in groups.						
B18 Members of different ethnic groups do not tolerate one another.						

C. EXTENT OF USE OF TECHNOLOGY

C1 Your workstation suits your tasks.						
C2 Productivity in the organization is satisfactory.						
C3 Have there been any accident in this company in the last two years ? Yes/no ?						

C4 What are the most common type of accidents that occur?

C5 Accidents occur because of employees misunderstanding instructions on how to use technology.						
C6 Training received to use new technology was insufficient.						
C7 Instructions are given in one language only to all cultures.						
C8 Technology used in this company is usually imported from another country.						
C9 Imported technology is adjusted to the needs of our organization.						

The following according to my view exists in our organization:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
C10 Instructions of technology is in the language of the country from where it is imported and/or in English but not in any of the 10 other languages used in South Africa.						
C11 Training on new technology is done mainly in one language.						
C12 Training on new technology is done in the language of the user.						
C13 Different training methods are used to train diverse cultural groups to use the same technology.						
C14 Employees view new technology as a threat.						
C15 The organization experienced problems with imported technology due to cultural differences between country of origin and the local employees.						
C16 Training on the use of new imported technology was sufficient.						
C17 Methods to facilitate the transfer of imported technology to this organization could improve. Suggestions : _____ _____ _____						
C18 Some technology is imported from countries of which the physical/body dimensions of employees are different from our country.						
C19 Imported technology fits the physical/bodily dimensions of people in our organization.						
C20 Physical/bodily dimensions of employees within the organization differ and causes constant adjustment to equipment.						
C21 Imported technology are successfully adjusted to fit the physical/bodily dimensions of users in our organization.						
C22 Employees view new technology as a challenge						

The following according to my view exists in our organization:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
C23 Technology transfer should take place considering the recipient company/country's culture.						
C24 Training is done in the language of the trainer.						
C25 The educational background of diverse cultural groups causes problems in the transfer of technology.						
C26 Differences in the time perspective causes lower productivity in the company.						
C27 New technology cannot be implemented due to cultural diversity in this company.						
C28 Physical/bodily dimensions between different cultural groups within the organization differ.						
C29 Different physical/bodily dimensions of employees are sufficiently taken into account when installing new technology.						
C30 Differences in physical/bodily dimensions cannot be ascribed to different cultural groups but is a natural phenomenon.						

D - MANAGEMENT OF CULTURAL DIVERSITY WITH REGARDS TO THE IMPLEMENTATION OF TECHNOLOGY.

The following according to my view exists in our company:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
D1 Technological change is viewed as a challenge and opportunity.						
D2 Policies on the implementation of technology are reviewed regularly.						
D3 There is openness to suggestions from all people in the company.						
D4 Our strategic plan on advanced technology is revised as needed.						

The following according to my view exists in our organization:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
D5 "We have always done it this way" is a reflection of how our company responds to new ideas.						
D6 Management keeps up to date with new technology and development.						
D7 Management accepts suggestions from operators of technology.						
D8 Our training and services reflect awareness of a diverse customer base.						
D9 Top managers are visionary and approachable.						
D10 Technology is improved on a regular basis in our organization.						
D11 Top management backs up its value on cultural diversity with action.						
D12 Time-management is difficult as it is perceived differently by different groups.						

E - HOW MUCH IS CULTURAL DIVERSITY VALUED IN YOUR COMPANY ?

In our company or organisation :	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
E1 Every staff member should be required to speak English.						
E2 Cultural diversity brings creativity and energy to a workgroup.						
E3 Minority group members should be expected to forsake their own cultures and adapt to the rules of the majority.						
E4 Multicultural teams can be stimulating and productive.						
E5 People should leave their differences at home and conform to company standards at work.						
E6 Technology should be adapted to suit every cultural group.						

In our company or organization :		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Unable to answer
E7	Training of new technology should be done in the home language of each worker.						
E8	Minimum educational requirements should be set before training takes place on new technology.						
E9	Flexibility to people's individual needs increase commitment and motivation of employees.						
E10	Cultural diversity only brings unnecessary conflict and problems in a work group using technology.						
E11	Same cultural groups stick together.						
E12	Differences often make people feel uncomfortable.						
E13	Certain cultural groups are more suited for certain jobs.						
E14	Certain cultural groups adapt easier to new technology.						
E15	There should be no double standards – the rules should be the same for everyone.						
E16	This country would be a better place if people would assimilate into one culture.						
E17	Some cultural groups regard technology as work for "dirty hands"						
E18	Training is needed to help employees understand each other and overcome communication barriers.						
E19	Managers have effective strategies to use when one cultural group refuses to work with another.						
E20	This country would be a better place if people were allowed to preserve their own cultures.						

Thank you for your participation in this research survey. All answers will be treated as confidential.

APPENDIX C: FREQUENCY DISTRIBUTION PER VARIABLE

1. LANGUAGE / COMMUNICATION

LABELS : B3, B4, B6, B9, C5, C6, C7, C10, C11, C12, C24, E1, E7, E18.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	7	2.78	2.78	0	0
1	21	8.33	11.11	21	21
2	77	30.56	41.67	154	308
3	21	8.33	50.00	63	189
4	92	36.51	86.51	368	1472
5	34	13.49	100.00	170	850
TOTAL	252	100.00		776	2840

n = 18 Mean : 3.079 Variance : 1.787
 Labels = 14 Std Dev. : 1.337 t = 1.839

2. RELIGIOUS BELIEFS

LABELS : B3, B12, B14, B15.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	2	2.78	2.78	0	0
1	9	12.50	15.28	9	9
2	30	41.67	56.94	60	120
3	7	9.72	66.67	21	63
4	19	26.39	93.06	76	304
5	5	6.94	100.00	25	125
TOTAL	72	100.00		191	621

n = 18 Mean : 2.653 Variance : 1.588
 Labels = 4 Std Dev. : 1.260 t = 0.514

6 . ETHNICITY VALUES.

3

LABELS : B3, B5, B12, B17, B18, E6, E7, E11.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	2	1.39	1.39	0	0
1	9	6.25	7.64	9	9
2	56	38.89	46.53	112	224
3	23	15.97	62.50	69	207
4	41	28.47	90.97	164	656
5	13	9.03	100.00	65	325
TOTAL	144	100.00		419	1421

n = 18 Mean : 2.910 Variance : 1.402
 Labels = 8 Std Dev. : 1.184 t = 1.468

7 . ATTITUDE.

LABELS : B2, B7, B8, B10, B11, B13, C13, C14, C22, C27, D1, D3, D4, D5, D9, D11, E3, E9, E10, E12, E13, E14, E15, E16, E17, E20

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	2	0.43	0.43	0	0
1	17	3.63	4.06	17	17
2	142	30.34	34.40	284	568
3	58	12.39	46.79	174	522
4	196	41.88	88.68	784	3136
5	53	11.32	100.00	265	1325
TOTAL	468	100.00		1524	5568

n = 18 Mean : 3.256 Variance : 1.293
 Labels = 26 Std Dev. : 1.137 t = 2.822

8 . TRAINING.

LABELS : C6, C7, C10, C11, C12, C16, C23, C24, C25, D2, D8, E7, E18.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	2	0.85	0.85	0	0
1	18	7.69	8.55	18	18
2	60	25.64	34.19	120	240
3	16	6.84	41.03	48	144
4	102	43.59	84.62	408	1632
5	36	15.38	100.00	180	900
TOTAL	234	100.00		774	2934

n = 18 Mean : 3.308 Variance : 1.598
 Labels = 13 Std Dev. : 1.264 t = 2.711

9 . VALUES.

LABELS : B2, E2, E3, E5, E10, E16, E19, E21.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	0	0.00	0.00	0	0
1	7	4.86	4.86	7	7
2	50	34.72	39.58	100	200
3	22	15.28	54.86	66	198
4	57	39.58	94.44	228	912
5	8	5.56	100.00	40	200
TOTAL	144	100.00		441	1517

n = 18 Mean : 3.063 Variance : 1.156
 Labels = 8 Std Dev. : 1.075 t = 2.220

10. IMPORTED TECHNOLOGY.

LABELS : C8, C9, C15, C16, C18, C19, C23.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	9	7.14	7.14	0	0
1	8	6.35	13.49	8	8
2	29	23.02	36.51	58	116
3	18	14.29	50.79	54	162
4	52	41.27	92.06	208	832
5	10	7.94	100.00	50	250
TOTAL	126	100.00		378	1368

n = 18 Mean : 3.000 Variance : 1.857
 Labels = 7 Std Dev. : 1.363 t = 1.557

11. MANAGEMENT.

LABELS : D1, D2, D3, D4, D5, D6, D7, D9, D10, D11, D12, E19.

VALUE xi	FREQUENCY fi	PERCENT	CUMULATIVE PERCENT	fixi	fixi2
0	1	0.46	0.46	0	0
1	8	3.70	4.17	8	8
2	52	24.07	28.24	104	208
3	33	15.28	43.52	99	297
4	98	45.37	88.89	392	1568
5	24	11.11	100.00	120	600
TOTAL	216	100.00		723	2681

n = 18 Mean : 3.347 Variance : 1.208
 Labels = 12 Std Dev. : 1.099 t = 3.270