Cape Peninsula
University of Technology

INCLUSIVE FITNESS: PARTICIPATORY DESIGN APPROACHES FOR ACTIVE AGEING.

by

RAEL GLEN FUTERMAN

Thesis submitted in fulfilment of the requirements for the degree

Master of Technology Industrial Design

in the Faculty of Informatics and Design

at the Cape Peninsula University of Technology

Supervisor: Mugendi M'Rithaa
Co-supervisor: Dr Simeon Davies

Cape Town
December 2007

DECLARATION

I, Rael Glen Futerman, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed  **Date** 10 MARCH 2008

ABSTRACT

This thesis tests the Usability, Safety and Attractiveness Participatory Design model (USAP) in the field of inclusive fitness. The focus is on improving compatibility between elderly people and fitness products. Three participatory design (PD) workshops were carried out with potential users ranging from 20 to 80 years of age. The research not only includes current elderly people but also those who will be entering this age bracket in the next ten years. Although the main focus is on the elderly, younger participants were included, and acted as a transgenerational audit. The first PD session made known possible avenues for exploration; the second session introduced a new group of people to the research and acted as a check to see if a a wider audience of older users had similar needs to those uncovered so far; the third session involved middle age participants who will be entering old age in the next ten years. Concepts were generated and participants commented and critiqued them.

Keywords: Participatory Design (PD), Ageing, Transgenerational design

ACKNOWLEDGMENTS

Firstly I would like to acknowledge the people who participated in the PD workshops. Without your assistance this project could not have happened. I would also like to express my sincere thanks to Bridget Parr of the Human Performance Laboratory of the Department of Sport Management, CPUT for her time and patience.

DEFINITIONS AND CONCEPTS

Active Ageing

The World Health Organization defines Active Ageing as (WHO 2002:12): '*the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age*'.

Activities of Daily Living (ADL's)

A measurement tool for functional status of individuals and refers to the six basic ADL's on the Independence in Activities of Daily Living developed by Katz (1970). These are bathing, dressing, toileting, transferring, continence, and feeding.

"Extra-Ordinary Ergonomics"

An approach to ergonomics that focuses on accommodating small and large people, people with disabilities, the elderly, expectant mothers and children (Kroemer, 2005).

Empathic Design

An approach to design where the user's perspective is attempted to be understood by the designer, and their emotions included alongside physical considerations.

Epidemiology

The study of how often diseases occur in different groups of people and why.

Ethnography

A social science research method based in fieldwork which entails personal experience and possible participation.

Gerontology

The study of aspects of aging such as social, biological and psychological. These are important aspects to understand in empathic design.

Gerontechnology

Multidisciplinary field including Human Factors, Social Sciences, Gerontology, Design and Engineering in which technology and ageing are seen as closely intertwined in the social context, as apposed to separate issues and fields of study. Key focus is on consumer pull as opposed to technology push (Clarkson et al, 2003: 295).

Inclusive Design

Design approach that expands the target group to include the needs of the widest possible audience, irrespective of age or ability usually taken to be synonymous with Universal Design.

Medical Model

This model of disability and ageing suggests that a person is disabled by their own condition. Correction of the impairment is done through medication, surgery and rehabilitation, and design focuses on assistive/ adaptive equipment (Clarkson et al, 2003: 598).

Participatory Design

Participatory Design is a method where the end user of a product is given a [equal] part in the construction and implementation of the design. It aims to bring together all the stakeholders [partners] in a project at the earliest possible stage of development. The model used in for this research project will be the User, Safety, Attractiveness and Participation model (USAP).

Population Ageing

The definition given to the steady increase in percentage of the older population.

Social Model

The Social model of disability and ageing has begun to replace the medical model, and believes people are "disabled or enabled by the social context in which they function" and suggests amendments to the physical environment

or social context can reduce or remove the disability (Clarkson et al, 2003: 598).

The Elderly / Third Age

Fisk defines old age as from 60 years. This is further broken down into *younger-old* from 60 to 75, and *older-old* from 75 years on (Fisk et al, 2004 in Kroemer, 2006: 128). This period of ageing (60+) is also referred to as the third age.

Transgenerational Design

This design methodology aims at making products and environments that enable older users through inclusion by catering for physical and sensory impairments associated with ageing (Pirkl, 1994).

Universal Design

Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (Mace, 2007).

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

This study explores the merits of a participatory model of design with particular focus on products for a growing population of elderly and disabled users. There are many ways in which users or consumers may play a participatory role in the practice of design. The term participation is often used to refer to a process of feedback and evaluation that occurs relatively late in the design process. In such an approach to participatory design, consumers generally form a test group that is used to evaluate a product that has already been conceived and concepts designed. However, this thesis argues for the benefits of including users at the outset of the design process. This approach recognises the importance of involving potential users in the conception of products, services and systems.

Including potential users at the beginning of the design processes has a number of advantages. While involving users at the end of a design process may allow some refinement of the original concept or product, including user's right from the start allows more room for innovation. Importantly such innovations would be conceived in relation to user needs. This allows the potential for entirely new innovations to emerge out of user needs that designers may otherwise not have recognized. Such innovations are particularly beneficial when designing products for a group of people whose needs are different from those of the designer. For this reason my thesis is particularly focussed on the potential of participatory design in producing inclusive fitness equipment for the elderly and for those with disabilities.

However, while such design may be able to help those with particular needs it is also important to make products that are marketable to a large group of people. Therefore they must be transgenerational in appeal. I will show, firstly, that the elderly form a large and steadily growing market. Secondly I will argue for the merits of combining an inclusive model of design with a participatory approach, as they are similar in ideology (Luck, 2003).

2. POSITION STATEMENT

2.1. Problem Statement

This thesis deals with two main issues within the domain of inclusive fitness. The first focuses on the lack in compatibility between the needs of ageing users, fitness equipment, and the environment in which this interaction takes place. The second deals with the lack of participation of ageing users in the design of fitness equipment.

The lack in suitable fitness equipment available to the active elderly has resulted in exclusion from fitness facilities. By addressing the needs of the active elderly through participation in the design process this project aims to provide more applicable inclusive fitness equipment, thereby reducing the number of barriers faced by the older people wanting to engage in fitness activities.

2.2. Background to the Problem

The percentage of older people is increasing the world over. Koncelik (1998: 117) refers to this phenomenon as "the single most important change occurring to humanity on this planet." Projected statistics reveal that by the year 2050 the population of adults aged 60 years and older will outnumber the population of children 14 years and younger for the first time in human history (Ehrenman, 2005). The main contributors to this unique phenomenon are the reduction in fertility rates and increased lifespan. Another contributor is advances in medicine, which is shifting the major causes of death from famine, epidemics and wars to age related problems (Storie, 2007).

Developed countries will see a rise in their older populations from 10% to 21% (*World Assembly on Ageing* 2002; Velkoff & Kowal, 2007: 5). This is due to the baby boomer generation reaching the age of 60 at approximately the same time. Sub-Saharan African countries will see an increased annual growth rate of people aged 60 years and older resulting in a doubling of the population of people aged 60 years and older (Figure 1). In some developing countries the older population is expected to increase fourfold (*World*

Assembly on Ageing 2002). Only the poorest developing countries are expected to remain constant to current population percentages (Olfs, 2006).

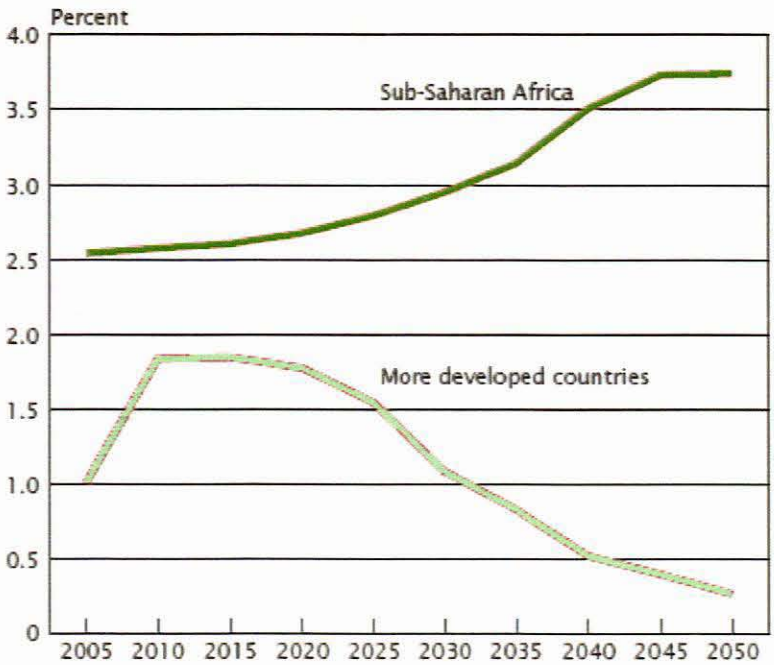

Figure 1: Doubling of Sub-Saharan Africa's older population

In 2006 South Africa had the second largest population in Sub Saharan Africa (Fig. 2) of people aged 60 and over (Velkoff & Kowal, 2007: 6) . South Africa also has the largest percentage in relation to total population of people aged 60 and over, which is expected to rise (Figures 3a & 3b) from 7.9% in 2006 to 12.4% in 2030 (Velkoff & Kowal, 2007: 10; U.S. Census Bureau, International Data Base, 2007). These statistics retrieved from the U.S. census bureau are slightly different to local statistics from StatsSA which state South Africa will see a rise in the percentage of people aged 60 years and above from 7.3% to 10.8% in 2050 (Stats SA, 2002; Kinsella & Ferreira, 1997). Either way though it is evident South Africa has a rapidly increasing older population in need of investigation. It can also be said that South Africa is the *oldest* country in Sub-Saharan Africa in terms of population percentage.

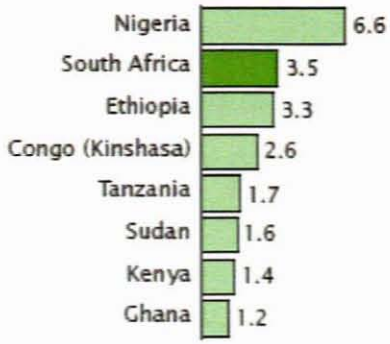

Figure 2: Percentage of South Africa's population aged 60+

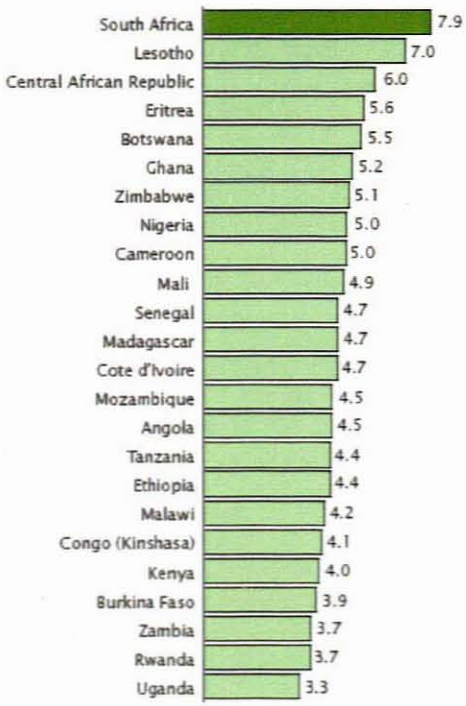

Figure 3a:Comparative percentage of SA pop aged 60+ in 2006

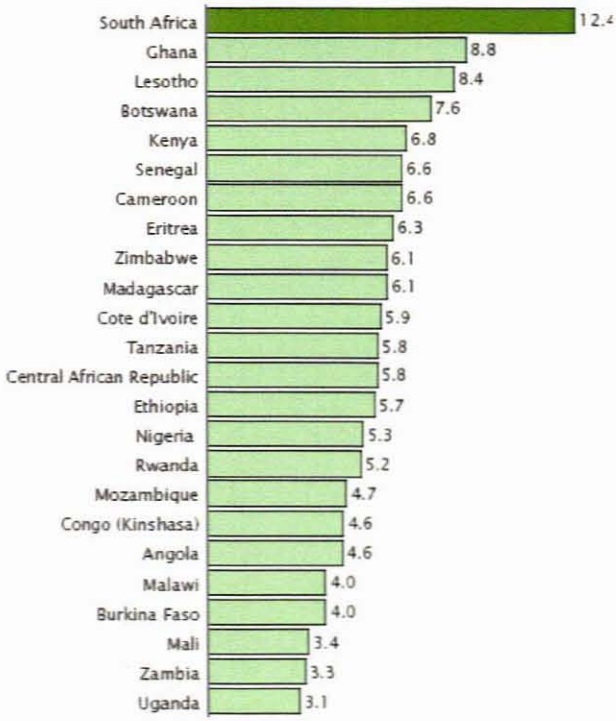

Figure 3b: Comparative percentage of SA pop aged 60+ in 2030

Figure 4-7 represent South Africa's population by race. What is interesting is how the population pyramid changes into a population obloid across the races. South Africa is unique in that it exhibits population ageing features of both developed and developing countries. This is due to the legacy of Apartheid and the separate development of different races.

South African's over the age of 50 have lived most of their lives under the apartheid system. Older adults in South Africa experience a larger inequality amongst peers than younger South Africans, due to restrictions placed on the black population during apartheid. These restrictions included employment, residence and education (Lam, Leibbrandt & Ranchhod, 2006: 214). This has had a knock on effect on the different population ageing features as South Africa's races experienced different levels of development. For example data on life circumstances of South Africans aged 65 and over reveal that living conditions vary according to the life patterns of the different racial groups that make up the population. Ramashala (2000: 2) states that "*Race, gender and place of residence, whether urban or non-urban, remain the most distinguishing features of the society, revealing past discriminatory practices*".

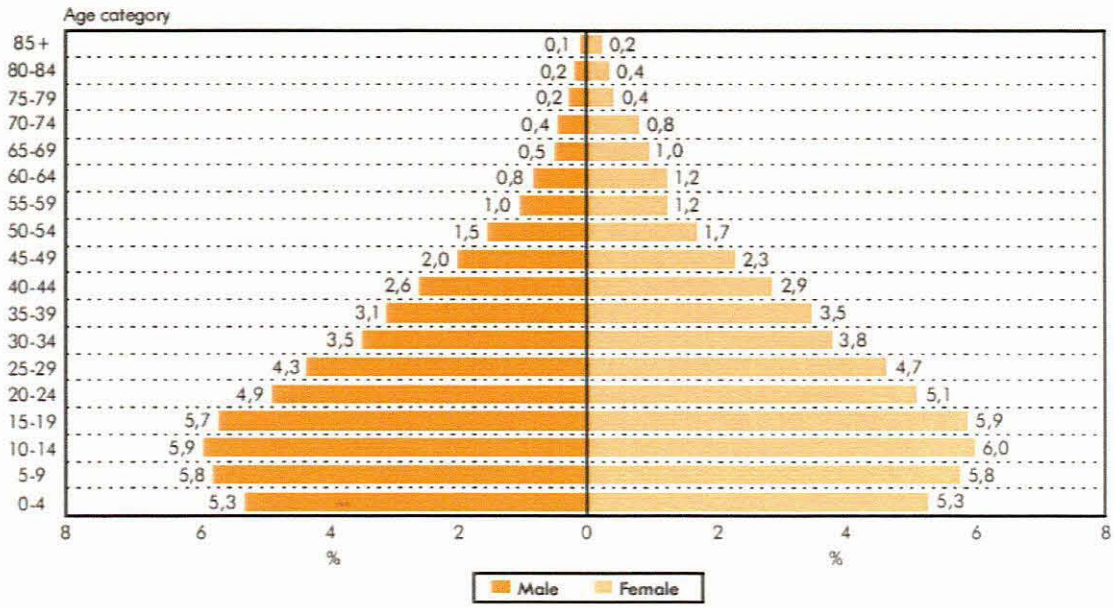

Figure 3 represents the black South African population. The large percentage of children under fifteen years of age indicates a high birth rate. However this number is less in the 0-4 age group. This narrowing base indicates a low and recently declining birth rate. Currently the percentage of older people is minimal showing a low life expectancy, however this is expected to rise due to advances in medicine, declining fertility rate and the large 'youth bulge' represented by the 5 – 19 age group. The pyramid does not narrow in the 5-9 age band which indicates a low infant mortality rate. A greater percentage of elderly females than males show a longer female life expectancy, in this case from 65 years of age and above females outnumber males by a factor of 2:1. This pyramid shows a high number of people in the reproductive age group of 20-39 years of age which suggests a rapid natural increase in the population.

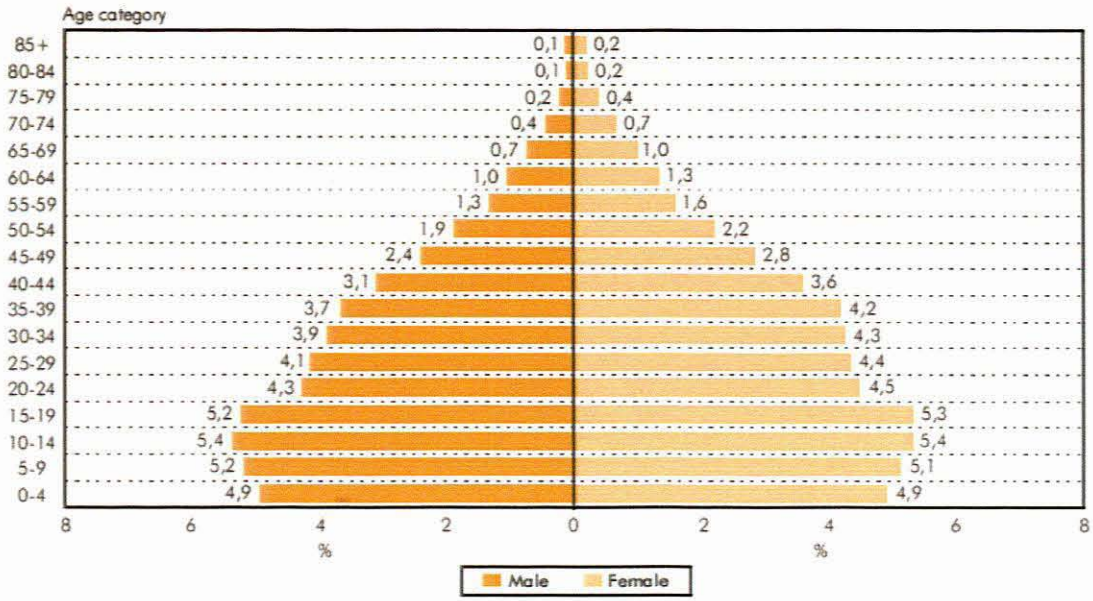

Figure 5. Distribution of the Coloured Population by age group and sex

The large percentage of children aged 15 years and younger indicates a high birth rate of the coloured population of South Africa, however the tapering at the bottom of the pyramid suggests this birth rate is slowly declining. The tapering in the top half of the pyramid shows a low life expectancy. The percentage of older males aged 65 years of age and older is at 1.5%, while the percentage of females is almost double this at 2.5% indicative of a longer female life expectancy. The pyramid does not narrow at the 5-9 age band which shows a low infant mortality rate. The decline in people aged between 20 and 39 years of age indicates fewer children and thus a slow natural increase in population.

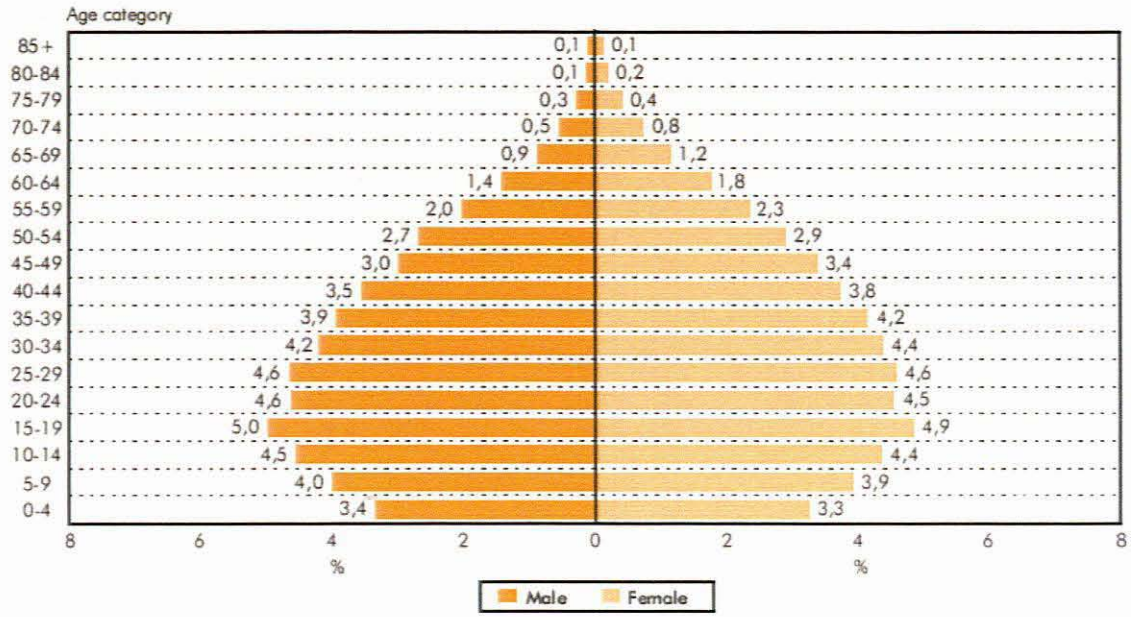

Figure 6. Distribution of the Indian/ Asian Population by age group and sex

The number of children aged 15 years and younger is decreasing substantially indicating an already low birth rate which is gradually decreasing. More people than in the previous graphs are reaching old age. This portion of the South African population also has a low infant mortality rate. Again there are more older females than males indicating a longer life expectancy for females.

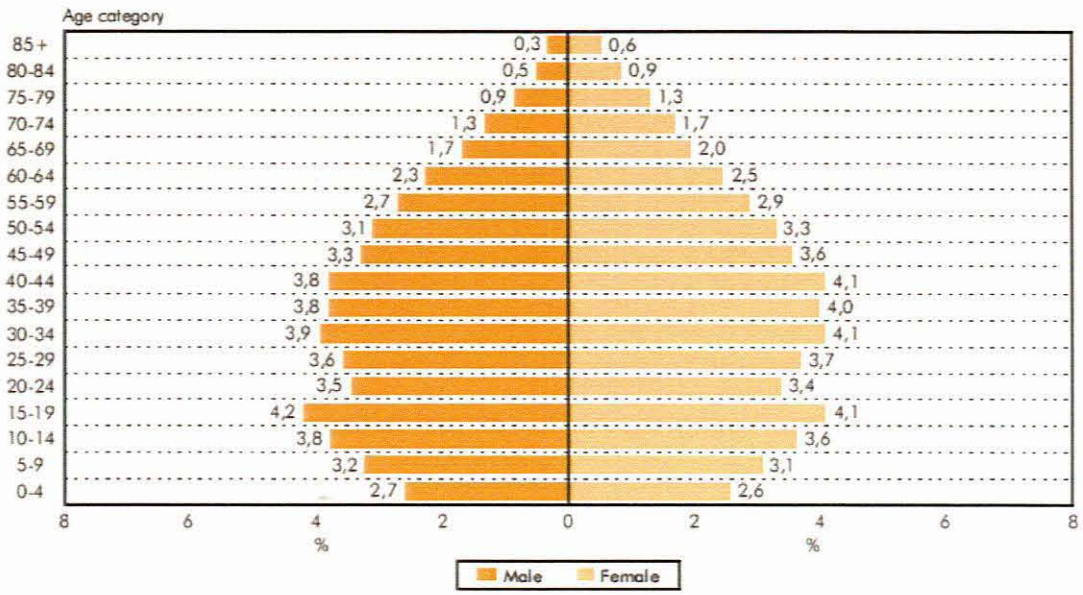

Figure 7. Distribution of the White Population by age group and sex

The population pyramid of white South Africans is very similar to that of the European demographic. This is typified by a larger older population and a rapidly declining birth rate. Elderly males make up 4.7% of the population while elderly females make up 6.5%, therefore the elderly comprise 11.2% of the white South African population. The more rectangular shape represents this low birth rate and low death rate. The birth rate is low and falling. As with the other South African population pyramids there is a low infant mortality rate. Another similarity is a longer female than male life expectancy. There are few people in the reproductive age group of 20-39, which suggests less children and a slow natural increase in population.

Black South Africans constitute the largest percentage of elderly citizens at 67%.

Within South Africa, the Western Cape has the largest population of people 80 years and above, and the second highest percentage of elderly people living in urban areas at 91.14% (HSRC, 2003: 46-47).

The challenge to designers is to meet the needs of the growing percentage of older people. Older people are a heterogeneous group as people all experience ageing differently. Designers therefore need to cater to a vast amount of individuals, as opposed to a group with uniform needs. People experience ageing induced sensory, strength, agility, mobility and cognitive limitations to different degrees and in different ratios (Benktzon, 1993; Pirkl, 1994; Koncelik, 1998; Jordan, 1999; Goldsmith, 2001). Due to these diverse ageing trends people's individual traits become more pronounced with age (Pirkl, 1994; Ervik, 2006: 4; Coleman, 2003: 121). In his book *Transgenerational Design,* James Pirkl states that products and environments are usually directed toward a single disability, "thereby failing to accommodate the combined effects of multiple losses" (Pirkl, 1994: 42), which is often the case with ageing. Therefore designs that wish to include the older population need to meet a range of requirements. Koncelik (1998: 117) encourages designers to "relate the human factors of aging" to the products that they design.

2.3. Objectives of the Study

- This study aims to test participatory design methodologies in the context of active ageing with focus on inclusive fitness equipment.
- To assess the appropriateness of a participatory design model for adoption/ use in the design of inclusive fitness equipment.
- To actively engage potential users in the design process as the *control agents.*
- Transgenerational fitness product concepts.

2.4. Research Questions

The area of active living is one where design can play an important role. The aims of design for active ageing are to promote an active lifestyle, improve inclusion/accessibility to activity areas and equipment and facilitate users' independence amongst the older portion of the population.

The area of inclusive fitness will be explored through the following research questions:

Research Question One - In what ways are the older population excluded?

Research Question Two - What are the needs of the active elderly?

Research Question Three - In the context of activity areas, how can compatibility be improved for transgenerational use and in turn promote independent living, participation and social inclusion?

2.5. Significance of the Study

Transgenerational accommodation is becoming an increasingly important research area worldwide. Japan, the United Kingdom, Scandinavian countries and the USA and other economically advanced nations have contributed significantly to the knowledge base. This is due to ageing trends related to these countries, such as the Baby boomers in the USA and UK, Japan having the world's oldest population. South Africa has gone so far as highlighting the need for inclusive environments and stressed the importance of social inclusion of the elderly, but has not developed specific contextual design guidelines to do so. This study aims to develop local transgenerational guidelines related to active living, with applications to a wider context. It aims to promote transdisciplinary collaboration (i.e. sports management and Industrial Design – Ergonomics and design), thereby increasing what Gibbons, Nowotny, Limoges, Schwartzman & Trow (1994, p.1 in Toft & Joubert, 2005) term Mode 2 knowledge (Fig 8) which involves multidisciplinary teams brought together for short periods of time to work on specific, real-world problems This project will involve the departments of Sports Management and

reconciles the views of the related disciplines of industrial design and ergonomics. Specifically it explores the synergies between participatory design and participatory ergonomics methods.

Mode 1	Mode 2
Academic	Context-driven
Investigator-initiated	Problem-focused
Discipline-based	Interdisciplinary

Figure 8. Differences between Mode 1 & Mode 2 theories of knowledge production (after Gibbons et al)

3. Research Design and Methodology

3.1. Focus of the study

A key area of concern in this thesis is the implications of population ageing on design. My focus will be on the needs of the ageing population and how to improve the design of relevant products. The focus of my study is limited to the area of inclusive fitness. The participants involved within the project are the active elderly however younger participants are also included to ensure that the process evolves a truly transgenerational solution that can enhance the lives of users of all ages.

Another important output of this study is the testing of the Usability, Safety and Attractiveness Participatory (USAP) design model (Fig 9) (Demirbilek & Demirkan, 2004) within the context of inclusive fitness; and further development of this model to improve the transgenerational applicability of its output in the form of inclusive fitness equipment. This will be done firstly through an investigation into other design methods and guidelines focussed on design for the elderly; and secondly through testing with a user group in the design of inclusive fitness products.

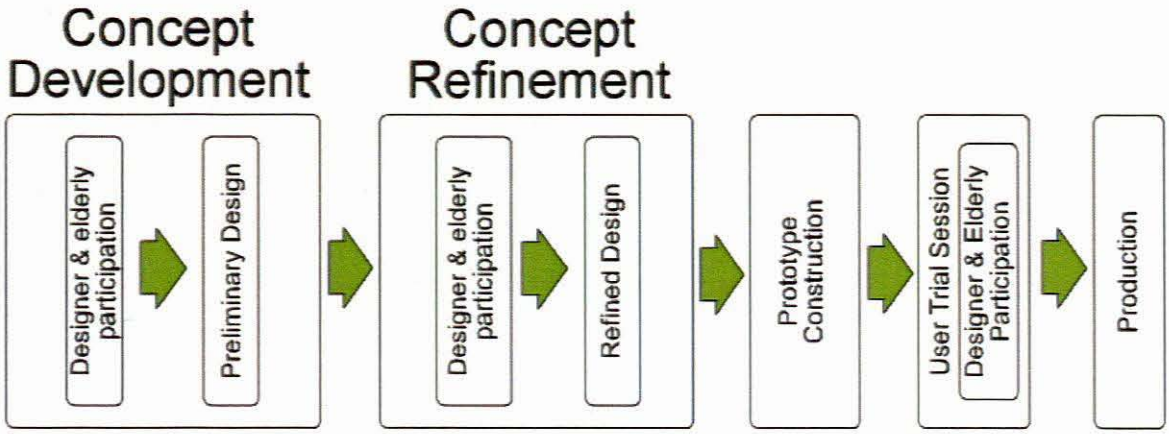

Figure 9: The USAP design model

3.2. Methodology of the study

This study predominantly utilises qualitative design research methods for data collection and analysis, in the form of semi-structured interviews and field ethnography as well as participatory methods based in the USAP design model (Demirbilek & Demirkan, 2004).

Although principally based on qualitative data, this study also makes use of quantitative information such as ergonomics data and market research related to the ageing population's needs. The perceived needs of the users formed during field research are combined with the quantitative data. User feedback in the form of Participatory Design (PD) workshops are used to validate findings and make known new information. This is done to validate the qualitative research findings through triangulation. The triangulation process (Fig. 10) chosen will be *method triangulation* which compares the findings gathered form varied methods of research (Visocky O' Grady, 2006: 77).

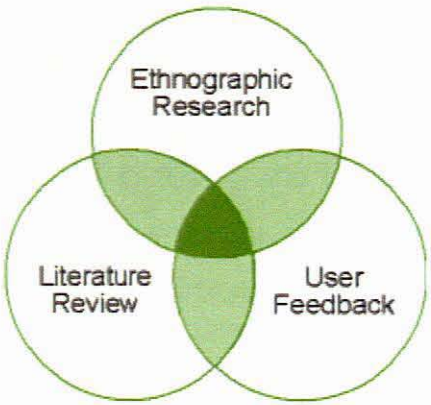

Figure 10. Method triangulation

I have chosen to use qualitative methods as the primary form of research as they allow for issues to be explored in depth and in detail. These methods also endeavour to reveal specific qualities of a field, in this case ageing and its implications on fitness equipment. Such insight into the participant's personal experiences and perspectives allow the designer to better understand and empathise with the user, which can produce a more appropriate product. Empathic design methods take into consideration the emotions of the participant as well as rational considerations such as ergonomic data. This empathetic approach to design leads to solutions that better consider the user's perspective.

As qualitative research should be undertaken within real-world settings (Patton, 2002: 39), all interactions and observations were carried out within the Human Performance Laboratory in the Department of Sport Management at the Cape Peninsula University of Technology (CPUT), as this is where the participants attend to their regular rehabilitatory, personal fitness routines. Observations included participant's interaction with fitness equipment, with the environment and with their personal trainer. It was important to observe the personal trainers needs as well as the participants as often both have to interact with the equipment at the same time. The chosen participatory design methods allow for the inclusion of the user, not only in information gathering, but in concept creation as well. The USAP design model adopted for this thesis was developed for use solely in design projects concerning the elderly and ageing-in-place. Population ageing is resulting in the emergence of more multi-generational families it is becoming increasingly important to design

products that are usable by people with different age-related needs. Designs need to work for a number of different users across generations as families are sharing the same environment. A goal of this thesis was to therefore make the USAP model more inclusive and transgenerational in applicability thereby ensuring more inclusive products are produced. Hence the inclusion of younger participants acting as a transgenerational audit.

3.3 Research Procedure

Each PD session was held in a familiar environment to the participants. PD sessions with Group 1 members were held in their exercise environment at the Human Performance Laboratory (HPL) in the Department of Sport Management at the Cape Peninsula University of Technology (CPUT). Initially the participants were addressed as a group, however their visiting times differed and it became difficult to organise sessions where everyone could be present. Therefore the subsequent sessions with Group 1 participants were held with individually. This had the positive effect of allowing the participants to voice opinions in private. Once identical research was carried out with all the participants these findings were collated and presented to each participant for verification.

PD sessions with Group 2 were held in the retirement village where they all reside. As the participants in this group meet at least once a week to talk and play cards it was easier to speak to them all at once. This fact also allowed for a faster turnover in ideas as small groups consisting of 6 people can produce up to 150 ideas in as little as half an hour (Jones, 1992 in Demirbilek, 1999: 73).

Interactions with Group 3 were also held in their place of residence.

Other general conditions were as follows:

- Each session lasted between 30 and 45 minutes,
- Participants chose the methods of input, whether it be drawing, writing or talking (often a combination of the above),

3.4. Summary

The designer and participants derive mutual benefits from the use of a participatory design process. These design methods however present both benefits and challenges. The designer gains knowledge of the participant's needs and preferences through first hand interactions. These exchanges of knowledge can allow the designer to better understand the potential users and make known many ideas the designer might not be aware of. Such empathy can help the designer to deliver a more appropriate product. As a result the designer can achieve greater consumer knowledge, which can also influence future design directions. Participants are at the centre of the participatory design process as this empowers the potential users as they decide what products are to be taken forward. The designer also benefits as by adopting the role of facilitator during the PD process as there is a broadening of the designer's perspective about the opinions, requirements and ideas of elderly participants.

4. DESIGN AND THE AGEING POPULATION

4.4. Introduction

There has been a shift in the age balance of the population over the past 150 years, resulting in a older population. Currently the human population balance is changing from previous typical ageing trends. For the first time each subsequent generation is not getting larger, and the bulk of the population is actually older. Fertility rates are decreasing and mortality rates increasing. We are no longer living in a youthful world. For the first time in recorded history the population of adults aged 60 years and older will outnumber the population of people 14 years and younger (Ehrenman, 2005).

Peter Laslett described this demographic phenomenon as a 'secular shift in ageing' (Fig 11).

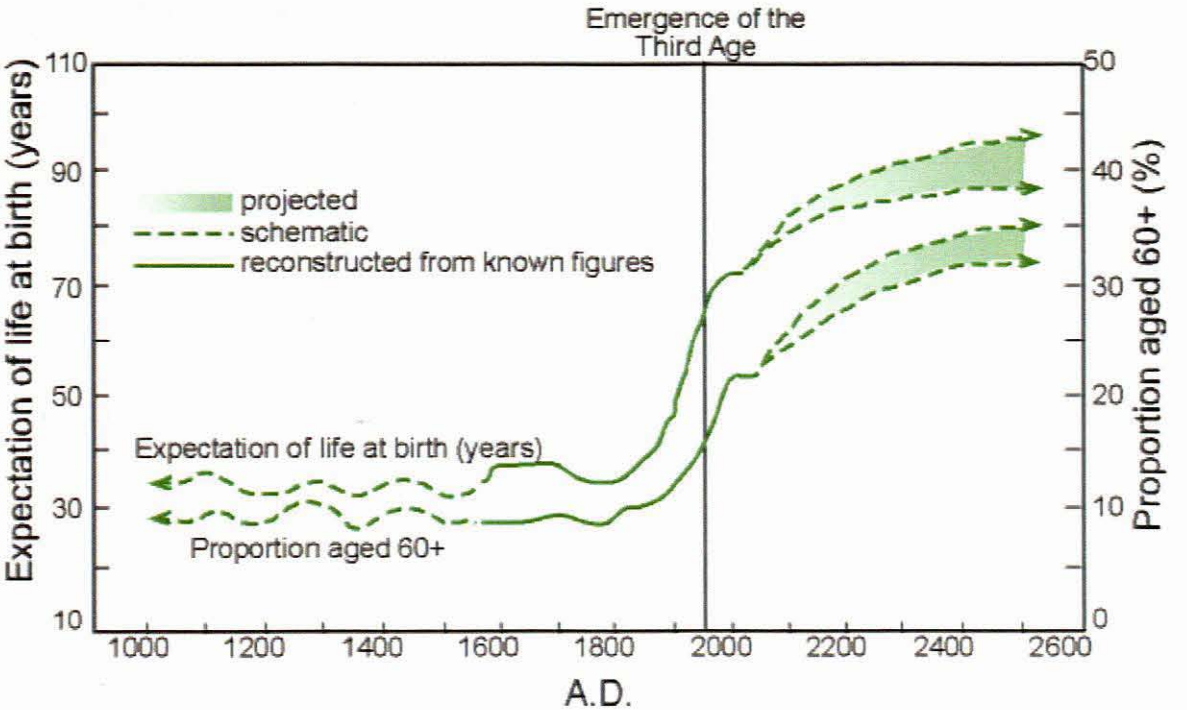

Figure 11: Laslett's secular shift (adapted from Laslett 1989)

This population ageing is more prevalent in developed countries but is also beginning to occur in developing countries (Coleman, 2003:123). This fact that we are living longer has added what Laslett terms 'the third age', which is essentially another stage in the life course. Prior to this the two stages of life were work and retirement. He suggests that this third age offers people opportunities to fulfil personal goals and life plans. However this implies the means to do what one wants, ie wealth and health. It if for this reason that the concept has received some strong criticism of it being elitist (Jyrkämä, 2). This could be seen to be the case for a large portion of aged South Africans. Many elderly people in South Africa do not have the wealth to enjoy this stage and have to work well into old age.

4.5. Shifting views on the older population

Before massive economic and social changes heralded by the industrial revolution, older people were generally held in high regard as they were seen to have the knowledge and wisdom of experience. They were invaluable advisors to those seeking information regarding traditional customs and rituals, tool making and crafts, politics and warfare (Pirkl, 1994: 8). In pre-

industrial society, as a person aged their changing abilities were matched to different tasks. There were different roles for people with different capabilities, for example if someone grew too old to work a physically demanding job they weren't seen as useless, but rather reassigned to a different, less demanding job more suited to their abilities, often in an advisory role. Thus a person could remain productive into very old age.

Attitudes toward the elderly however, went through a major transition in Western society during the industrial revolution (Pirkl,1994: 9; Oliver, 1990: 28). Figure 11 portraying the 'secular shift in ageing' also shows that the industrial revolution and population are closely linked. Coleman (2003: 125) states that despite this close link a significant mismatch has arisen. He states that most of the built environment is no longer suited to the people who inhabit it. Most products and buildings do not meet the need of the ageing population. This is due to the fact that the bulk of these were designed for a youthful population with less ageing induces needs.
Industrial practices began to be dictated by a capitalist mindset which saw people who could no longer perform the required tasks eliminated from the production process. This included people with limitations either due to injury or age. Thus older workers were perceived as disabled as they could not keep up with the younger workers. Prior to the Industrial revolution a person's capacity to work rather than a formal retirement age dictated their participation in the labour market (Johnson, 1993: 8). This discrimination on the account of age originated forms of ageism and shaped myths about ageing which are still experienced today.

This way of considering the elderly often still predominates in today's capitalist society. Most products are aimed at the working population with little attention being paid to the older segment of the population. In recent years, however, as the older portion of the population grows, and new approaches to age and associated disabilities are beginning to emerge, attitudes toward the elderly have been changing. Finkelstein (1980: 37) explains these changing perceptions of people with disabilities in terms of three historical phases.

Phase 1 describes Britain's feudal society prior to the industrial revolution while Phase 2 refers to the rapid industrialisation that occurred during the 1700 and 1800's. In this phase the focus shifted from the home to the factory and industries began to seek typically youthful attributes such as endurance, strength and agility over wisdom and experiential knowledge (Pirkl: 1994, 9). In order to increase production, businesses began to get rid of "slow" workers. This included the exclusion of older workers by businesses constituted the first retirement systems (Pirkl: 1994, 9). A rise in dependency ensued as there were not many policies in place for the support of older, retired workers. It wasn't until 1935 with the introduction of the Social Security Act (USA) that countries were committed to helping their elderly. Since then most government policies have however focussed on the supply side of labour and not on the demand side which may contribute to the exclusion of disabled workers rather than their inclusion (Oliver, 1990: 86).
The third phase (Phase 3) refers to the kind of society toward which we are currently moving wherein disabled people will be empowered by a number of factors such as new technologies and collaborative projects which take into account their needs (Finkelstein in Oliver, 1990: 27,28).

4.3 Changing paradigms

Design for ageing populations has looked at providing products that prolong the ability of individuals to perform Activities of Daily Living (ADL's). These products have generally been born out of the *medical model* of disability which is based on the medical and scientific expertise of professionals (Brandt & Pope, 1997). This medical discourse perpetuates the idea that the individual's inability to carry out a task is due to a personal impairment. The cause of the disability and the inability to perform the activity is therefore described as a medical condition (DPSA). This stigmatizes the individual as they are seen as disabled.

Design has begun to move away from the medical model and more toward the *social model*. The social model takes the wider view that the ability to perform activities is dependent on social intervention. Thus a person's inability to

perform a task is not due to their lack of ability, but due rather to the fact that the task environment is debilitating. A persons inability to perform a task is therefore due to fact that the environment is not compatible with that persons needs. Wattenburg (2004: 134) states "*The* [product or] *environment is positive and enabling when it supports a person's usage or functional capabilities or it can be negative when it is disabling, restricting a person's functional activities.*" Thus by taking peoples circumstances, limitations and needs into account when designing a product, that product can remove the need for specialised or medical products. For example by designing a can that can be easily opened by people with arthritis one removes the need for a product for use solely by that group.

Therefore the goal for a designer should be to design products and environments that can be used by as many people as possible regardless of their limitations. In some cases however specialised equipment is necessary for a person to achieve a specific task or ADL. It is then the designers' job to design environments that accommodate these pieces of equipment. An example of this would be accessible walkways for people using wheelchairs. By designing products, environments and services to cater for peoples limitations these then generally suit a wider audience. A more inclusive approach to design has meant products aimed at reducing certain people's inabilities to perform tasks are also suited to a wider audience.

As people grow older they face certain ageing-induced impairments, but these do not have to disable them. By designing compatible and accommodating products and environments the bulk of the needs of a wider audience are met.

4.4 Policies and Legislation Concerning Older People

4.4.1 Active Ageing

Rune Ervik highlights the main international organizations responsible for Active Ageing policies (Ervik, 2006: 1). These are the United Nations (UN) specifically the World Health Organisation (WHO) and the Organisation for Economic Co-operation and Development (OECD). The emphasis on

different aspects of Active Ageing is common among these organisations and usually reflect that organisations context and responsibility (Ervik, 2006: 6). Ervik describes how the WHO definition is based on the UN principles for Ageing and takes on a more holistic approach, whereas the OECD describes a 'productivist' approach based predominantly on a person's physical capacity to perform activities.

These organizations define Active Ageing as follows:

> *"...the process of optimising opportunities for health, participation and security in order to enhance quality of life as people age"* (WHO, 2002:12),

> *"...the capacity of people, as they grow older, to lead productive lives in society and the economy. This means that people can make flexible choices in the way they spend time over life – learning, working, and partaking in leisure activities and giving care"* (OECD 2000:126).

Another difference is that the WHO Active Ageing policies have a life course focus (Figure 12) as opposed to the OECD policies focus which is primarily on the transition-to-retirement phase. Thus the WHO is more transgenerational in its approach to its policies. This is important as preventative measures can be worked into policies which can prevent more expensive curative measures later on. The life course approach to chronic disease epidemiology states that the risk of developing chronic diseases cannot be attributable solely to a single time in a person's life, but is instead accumulative throughout the different stages of life from gestation to later adulthood. This is important to designers dealing with the physical aspects of active ageing as designs suited for use by the elderly population should also be usable by younger people. This multigenerational compatibility will hopefully encourage use by people at different stages of their life course. By designing exercise equipment that can also engage younger people in fitness routines designers can contribute to the prevention of NCD's often experienced by people later in their life.

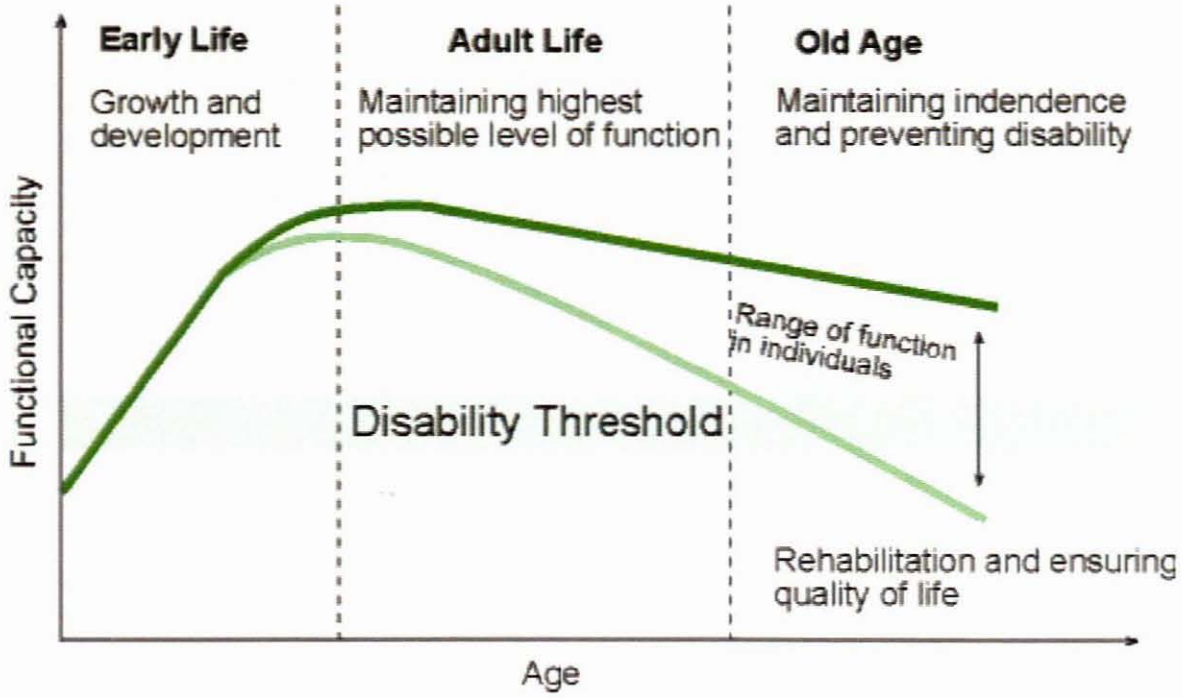

Figure 12: Life Course

It is said that active ageing policies must be sensitive to the following differences as the process of ageing does not happen in isolation, but happens in different national contexts:

- individual,
- social,
- economical,
- health,
- gender and
- cultural (Ervik, 2006: 7).

4.4.2 Rights of Older people in South Africa

The rights of older people in South Africa are protected by section 9 of the Constitution of the Republic of South Africa and the recently assented (2006) Older Persons Bill. This bill aims to:

A. Maintain and promote the status, well-being, safety and security of older persons;

B. Maintain and protect the rights of older persons;

C. Shift the emphasis from institutional care to community-based care in order to
ensure that an older person remains in his or her home within the community for as long as possible;
D. Regulate the registration, establishment and management of services and the establishment and management of residential facilities for older persons; and
E. Combat the abuse of older persons.

This bill does not however empower the older person, but focuses more on general rights and service delivery for the older person.

In Sub-Saharan African countries in general the UN, African Union (AU) and Non-Governmental Organisations (NGO's) have been pushing for the inclusion of older people into mainstream development thinking and address the welfare and capacity of its older population as integral within development efforts (Aboderin, 2005: 7). HelpAge International argues for:

> *"National and international recognition of the role of older carers in the form of targeted policies, programs and budgets and the involvement of older carers in the design and implementation of policies and programs particularly home based care programs"* (Ageing in Africa, 2006:4).

The African Policy Framework and Plan of Action on Ageing have a number of moral and economic reasons for the inclusion of older people in development policies (Aboderin, 2005: 7). These are:

- *Rights and Social Justice*
  Basic human rights enshrined in the UN Principles for Older Persons which include the right to independence, participation, care, self-fulfillment and dignity. Also in the UN Declaration on the Right to Development.
- *Older People's Contributions to Development*
  In the South African context of HIV/AIDS the Elderly often play a very important role by supporting children and grandchildren. An example

of good practice can be seen in South Africa where older people caring for grandchildren are eligible for social grants and school fee exemptions; and those caring for people living with AIDS can access a disability grant on behalf of the sick and get free ARV's from health centers (Ageing in Africa, 2006:3).

- *Prudence*

  By developing responses to population ageing now, African governments can avoid gradually implementations which will inevitably end up costing more. The idiom that prevention is better, and in this case cheaper, than the cure is applicable to health investment. By educating the older population on the benefits of exercise and providing the necessary means, governments can save themselves and its people large amounts of money. For example in the USA a number of economic benefits of exercise have been identified. These include:

  - The fact that $1 invested in physical activity in terms of time and investment leads to a $3.20 medical cost saving (WHO/CDC, 2000), and
  - If 10% of the populations' adults were to begin a regular walking program there would be a saving of $5.6 billion in costs relating to heart disease (*http://www.cdc.gov/nccdphp/pe_factsheets/pe_pa.htm*).

- Reciprocity

  The elderly generally contribute to the state for many years prior to retirement. Therefore a country should give back to these people.

4.5 Understanding the ageing user

4.5.1 The ageing process

People's perceptions of the elderly often arise from preconceptions and assumptions based in the past, however these perceptions need to be re-evaluated. The elderly are the most diverse portion of the population and what was perceived as old age 50 years ago is not necessarily so now. People are living longer and chronological age and real age can differ

substantially. The older percentage of the population is growing as people live longer, healthier lives.

The needs of the older user vary greatly from person to person as individual's age differently and experience sensory, agility and mobility limitations in different ratios and to different degrees (Pirkl, 1994: 4). The elderly are therefore not one homogenous group, but a heterogeneous group of people with different views and needs whose individual differences become more pronounced with age (Pirkl, 1994: 4). Pirkl states that products and environments are usually directed toward a single disability, "thereby failing to accommodate the combined effects of multiple losses" (Pirkl, 1994: 42), which is often the case with ageing. As people age differently they could experience any number of combinations of ageing-induced limitations.
The differences between elderly individuals are greater than between the elderly and another generation. There are, however, some needs which unite the elderly population. These include independence, inclusion and choice (Coleman, 1999: 162; Pirkl, 1994:70).
Judith Payling defines five key elements of independence. These are:

- *maintaining roles and relationships with others,*
- *contributing to the welfare of others,*
- *engaging in leisure/activities which are fun,*
- *managing life including work* and
- *taking risks* (Payling, 2003: 388).

It is important to take these factors into account when designing products to increase or extend a person's independence.

People view ageing in different ways, often depending where they themselves are in the ageing process. Figure 13 portrays a simplistic view many people, especially the young, have of the ageing process. It shows a steady growth of ones functional ability until retirement, at which point people's functional capacity is perceived to atrophy and they die.

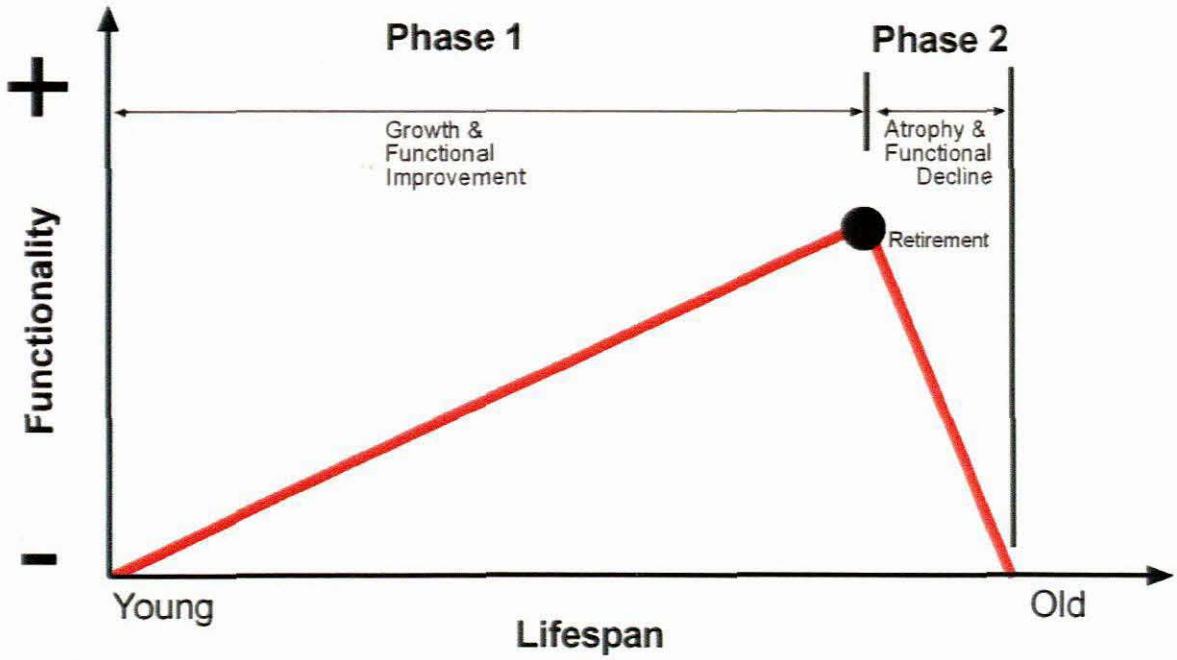

Figure 13: Popular conception of life span (adapted from Pirkl, 1994)

Figure 14 portrays a similar model, but acknowledges ranges of biomedical and environmental influences that affect the ageing process. Here growth and our functional ability increase until early adulthood, followed by a gradual decline in functional ability (Pirkl, 1994: 33).

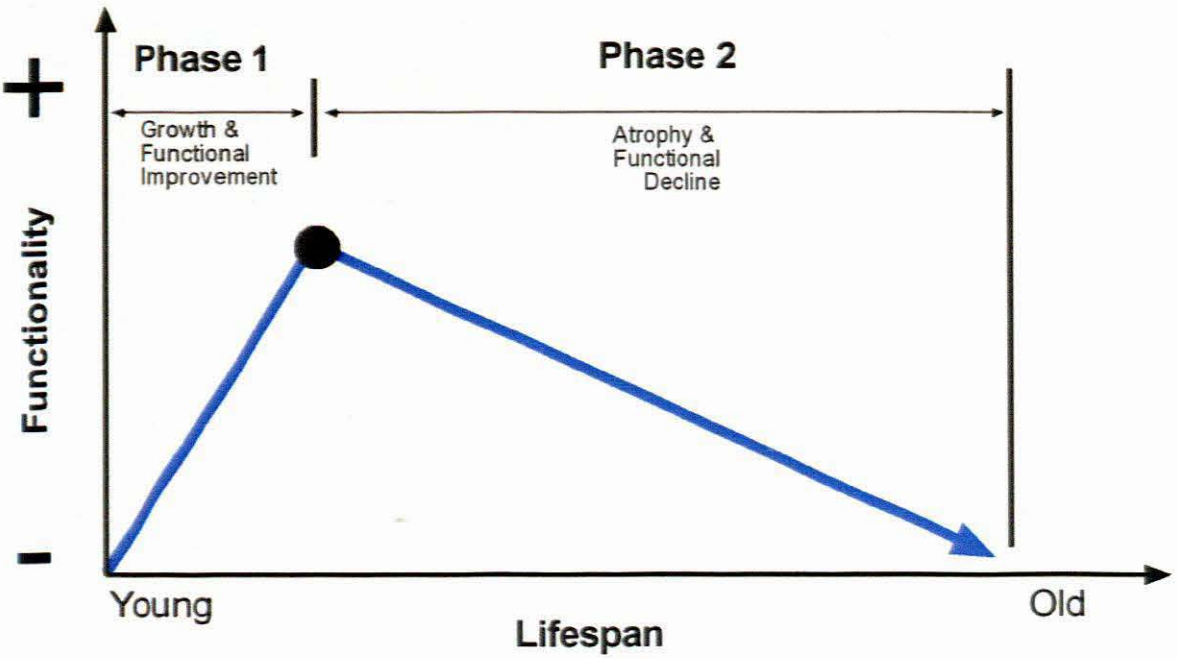

Figure 11: Model of two-phase life span (adapted from Pirkl, 1994)

These views of ageing are changing though as more companies are focussing in on retired people as a viable market. An example is the automotive industry. Both Nissan and Ford are developing concept vehicles aimed at the 50 to 65 year old age group, otherwise known as the young-old (REFERENCE). They realise retirees have money and time to travel. These companies are realising that today's elderly population is healthier, wealthier (35% of consumer spending in the UK is controlled by people aged 50+ (Coleman,1999: 160) and larger than ever before. Today most people can expect to live 20 to 25 percent of their lives in active retirement (Pirkl, 1994: 19). Figure 15 represents a more realistic model of ageing. The four phases are not uniform across the population. As people age differently and are exposed to different environmental and biomedical influences these four phases shift. For example where the solid line represents the average person, the dotted line represents a person who exercises very little and therefore does not use certain muscles and advances less toward functional improvement. As this person ages their exercise is decreased and therefore the ability to perform functions decreases more rapidly. Therefore phases 3 and 4

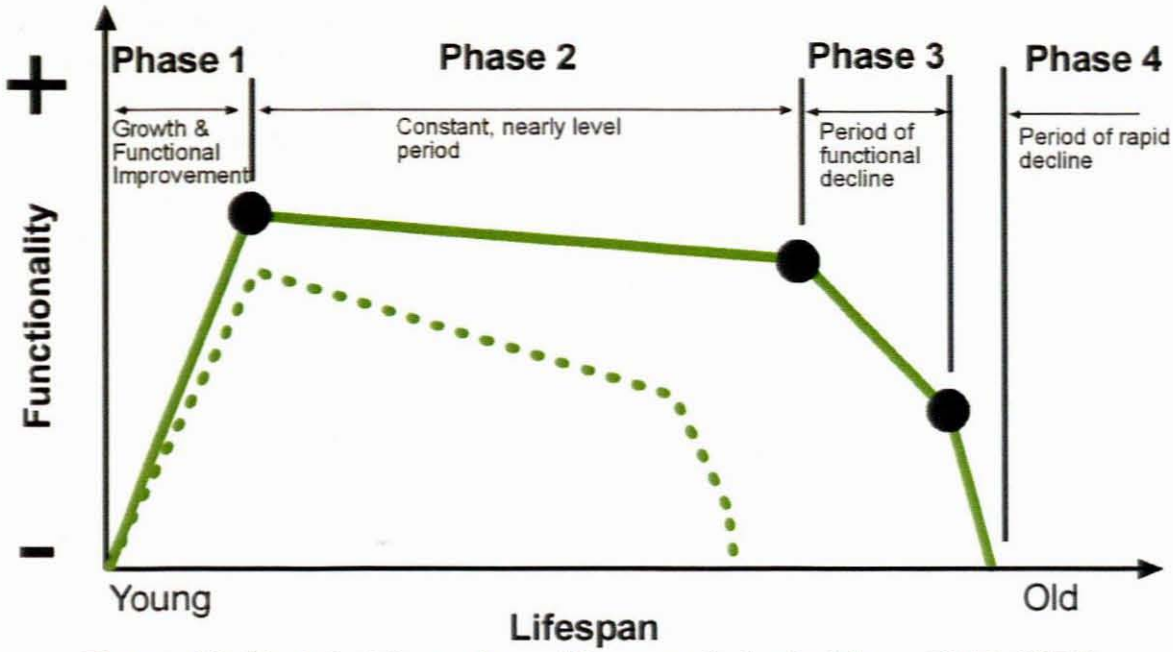

Figure 12: Model of four-phase life span (adapted from Pirkl, 1994)

are reached more quickly as the person is more prone to heart disease and other illnesses often associated with ageing.

Pirkl states that as we reach Phase 3 we rely more on "environmental support to compensate for the progressive decline of our functional ability" (Pirkl, 1994: 35). Products developed for the role of supporting people in performing ADL's are often termed assistive devices. These assistive devices often stigmatise the user as they have a medical aesthetic, which often results in people preferring to not use the product unless totally necessary. Exercise can also prolong our ability to perform ADL's and thus increase our independence. Exercise, even as late as during phase 3 is likely to reduce chronic diseases, associated with ageing such as depression or diabetes.

5 THE SIGNIFICANCE OF AN ACTIVE LIFESTYLE TO AGEING POPULATIONS

5.1 Introduction

Independence, which has been shown to be a priority for ageing populations, can be facilitated through maintained physical activity, leading to a higher quality of life. Other benefits of exercise include:

- Prevention or reduction of disability from chronic disease such as heart disease, obesity & diabetes,
- Reduced risk of falling,
- Development of strong bones, muscles & joints,
- Improved mood and sense of well being, reduced depression,
- Reduction in disabling conditions such as osteoporoses & arthritis,
- Reduced rate of ageing related cognitive decline
- Improved quality of sleep (CDC, 1; Ramashala, 2000; 2)

Leading an active life into old age also has personal and national economic benefits. For example if all physically inactive Americans became active the Centre for Disease Control and Prevention, CDC, would save an estimated 77 billion dollars in annual medical costs. This is 9.4 cents from every dollar of American healthcare spending (WHO/CDC, 2000). By leading an active life one spends less on medication, hospitalizations and physician visits (Pratt, 2000: 10).

Despite the benefits of an active lifestyle, the majority of the older population (two thirds) does not engage in the recommended amount of physical activity. This is due to a number of factors which include:

- Appropriate & accessible information, (personal health and suitable exercise; exercise locations suited to individual needs),
- Lack of suitable environments and products,

- Lack of motivation,
- Perceived lack of social support,
- Perceived lack of time,
- Lack of energy,
- Depression,
- Isolation,
- Lack encouragement, support, or companionship from family and friends,
- Side effects of medication, (energy, balance, alertness),
- Fears, (crime, falling, health event such as a heart attack) (Home Activity Monitoring System, n.d.).

The recommended amount of exercise as stated by the Surgeon General of America and adopted by fitness programs for the elderly is a minimum of thirty minutes of aerobic exercise a day. There are four types of exercise recommended for older adults. These can be seen in Figure 16.

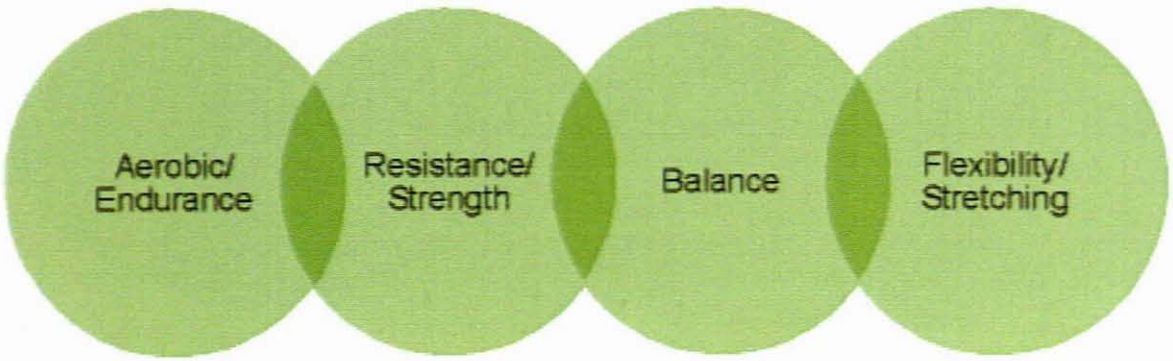

Figure 13: Four exercise types

There are various groups who can help influence physical activity amongst the older population; these include the consumers themselves, health care providers, the research community, the media and the design community. The role of design is to reduce the amount of barriers faced by people wanting to engage in physical activity by providing appropriate, accessible products, equipment, facilities and environments.

5.2 Cases for Inclusive Fitness Equipment

The design of fitness equipment can facilitate active lifestyles by increasing the compatibility between fitness equipment and the people engaging with it. Presented here are two models for inclusion and will be discussed in the context of the design industry. These are the human rights or legal case; and the business case. There is a relation to the idiom of the carrot and the stick, where the legal case is mandatory and the only return to a business is legal compliance, opposed to the business case which offers a return on investment and thus is more rewarding to the company. These cases encompass two distinct environments (Figure 17):

- The *work* environment – this is the environment in which the designer is employed and,
- The *use* environment – where users utilize the designed product/ service.

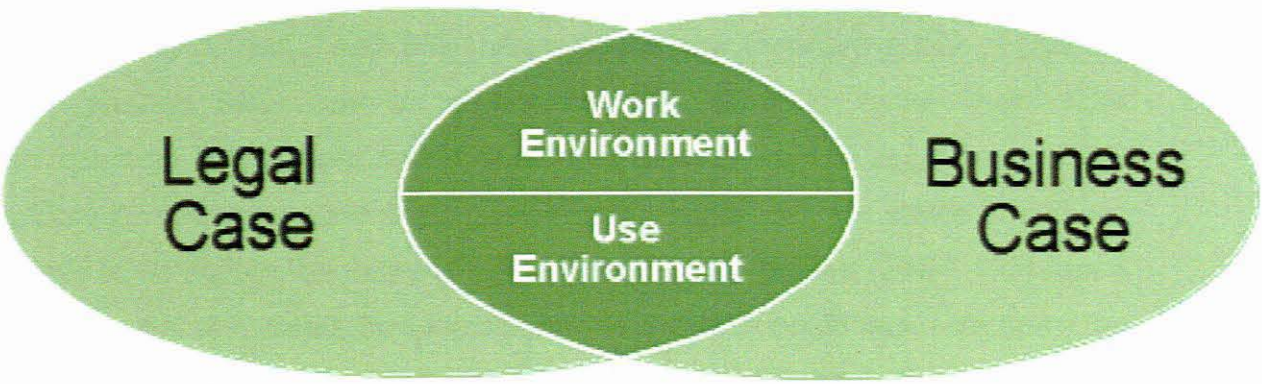

Figure 14:Cases for inclusion

5.2.1 The *work* environment

Legislation that relates to inclusivity is present in the UK and the USA. The USA uses the Americans with Disabilities Act 1990 (ADA) to push for inclusion of marginalized people of the population like the elderly and people with disabilities and UK legislation comprises of the Disability Discrimination Act 1995 (DDA) and the Special Educational Needs and Disability Act 2001

(SENDA, 2001). The arguments for the UK legislation are contextual but Casserley & Ormerod (2003: 143) state that they *"are applicable in other countries using their own legislative framework".* The arguments for inclusion in this legislation can thus be adapted to contextual needs therefore making them applicable to South Africa. These acts however focus on the provision of goods, rather than goods themselves and the DDA does not cover product design (Etchell & Yelding, 2004: 186; Ricability, n.d.).

The ADA and the DDA focus on employers and the requirements necessary to make the work environment more inclusive. The DDA stipulates that 3% of a major company's workforce should comprise of people with physical impairments. However companies do not seem to respond to this 'stick' approach to inclusivity. This can be summed up by the comment 'We'll do it when the customers ask for it' (Casserley & Ormerod, 2003: 163). This shows companies unwillingness to adapt. Michael Oliver (1990: 86) states how programs to promote inclusion in the workforce often fail as they focus on labour supply. He states how these programs could have a negative impact as they package disabled workers as a special case which can be exclusionary (Oliver, 1990: 86). Oliver states how there are a lack of policies that provide incentives to employers who want to make their work environment barrier-free, and how companies who want to design machinery usable by everyone cannot get government assistance. He states how there needs to be shift to the demand side of labour. Wattenburg (2004: 125) has a similar belief and states how legislation like the ADA could lack enactment as *"the people implementing the legislation have little to gain."* Both Oliver and Wattenburg argue for the business case as it focuses on the demand side of employment i.e. the carrot.

5.2.2 The *use* environment

Specific legislation applies to different use environments. These environments include education, transport, products and goods, and services. Legislation for inclusion aims to make these environments as accessible and usable to as many people as possible, regardless of limitations.
The business case offers designers, manufactures and service providers an incentive to design with inclusivity in mind.

The business case extends from the employment aspect of a business to its service/ product delivery. The growing older population has an impact on most companies providing services or goods. They have an increasing purchasing power. This combination of large numbers and economic purchasing power creates a 'demand pull'. Companies have to include this portion of the population in their market as it makes business sense; an increased consumer base means more return for that company. Older adults are increasing in numbers and creating a demand for products and services applicable to their unique changing needs. Coleman (ref) names a number of benefits to businesses that choose to embrace an inclusive model which include:

- Larger markets, and
- Opportunities for collaboration – businesses, public/private.

As an increasing percentage of older people start fitness routines, the supply of inclusive fitness equipment becomes more important. This can be seen in the United Kingdom (UK) with the formation of organisations such as the Inclusive Fitness Initiative (IFI) (IFI equipment standards,2006: 8).
Although The IFI's focus is predominantly accommodating people with disabilities, their checklist for inclusive fitness equipment is applicable to older people. The IFI aims to facilitate five key principles:

- Accessible facilities
- Provision of inclusive fitness equipment
- Staff with appropriate knowledge and expertise

- Facilities that develop and implement inclusive marketing strategies
- The development of other inclusive physical activity opportunities outside of the fitness suite environment (IFI equipment standards,2006: 8)

Within the *use* environment of fitness equipment there are both legal and business drivers. Reference here is to the UK as they can be seen as a good case study. Legislation and the DDA are the legal drivers in this area; however these have not been able to shape fitness areas inclusivity as much as one would hope. However the provision of inclusive equipment also presents a strong business case. In the UK the disability market offers £80 billion per annum and IFI sites current clientele are made up of approximately 10% people with disabilities (IFI equipment standards, 2006: 8).

6. UNDERSTANDING THE NEEDS OF ELDERLY USERS

6.1 Existing Guidelines

A number of guidelines relating to design for the elderly exist (Table 1). These guidelines convey ways to meet the general needs of the elderly population.

Table 1: Design Guidelines

Concept	Target Group/ Applications	Description and implications
"Extra-ordinary" ergonomics	Elderly	Focuses on physical aspects of design relating to functional ergonomics. Guidelines include: no stretch no bend, intuitive control placement (Kroemer, 2006: 160). Used in concept development and refinement stages of design (see methodology).
Universal design	Universal	Guidelines used for product evaluation. These include: Equitable use, low physical effort & tolerance for error (Coleman et al, 2003:13). Used in concept refinement stage and as a prompt for user evaluation.
Healthy Industrial Design (HID)	Elderly	General guidelines focussed more on user needs than product specifications, e.g. Understanding good body use (what we should do) is far more important than data on what we can do (Tye, 1991). Used in concept development stage of design.
Transgenerational design	Multi-generational	Human centred guidelines developed to make products accessible and appealing to young and old alike, and take into consideration multiple functional disabilities associated with ageing. These include: cross-sensory cuing, reduction in complexity of operation and use by a variety of physical and cognitive abilities (Pirkl, 1994: 110; Freudenthal, 1999: 203)
Inclusive design guidelines for older users	Elderly	Design guidelines that acknowledge the ageing process and the resultant needs of active elderly. Focus on ensuring age related impairments do not become disabilities (Huppert, 2003). Guidelines will be used to determine specific needs of older users relating to products and environments.
Universal design guidelines for exercise equipment	Inclusive	These guidelines are currently being developed by *Beneficial Designs.* This is being done by contextualising the 7 principles of UD. A key area of focus is aerobic and strength training equipment (UDGFE, 2005). This paper hopes to contribute to these principles.
Design guidelines to include elderly users	Elderly	These general guidelines are derived from Byert's text, *Back to Basics: Food and Shelter for the elderly* and include: legibility, accessibility and adaptability. These guidelines were expanded to include 'compatibility' by James Pirkl (Pirkl, 1994: 104). Guidelines will be used as checklist throughout design process.

6.2 Empathic Design

Within design it is important to understand the user. When that user base is the elderly, younger designers often have no reference point as ageing is experiential and most designers have not yet reached this age. Designers therefore develop methods and tools to better understand this increasing group of consumers. Although we all age differently certain ageing induced changes are common across a large percentage of the elderly. For example there is often a decline in muscle strength of approximately 25% by the age of 65 (www.mobilistrictor.co.uk).

The Mobilistrictor™ or empathy suit, is a tool to help designers better understand the physical needs of the elderly population by enabling the designer to experience firsthand the physical limitations of old age (www.mobilistrictor.co.uk). The suit however cannot imitate cognitive limitations and therefore cannot fully allow the designer to experience old age. The suit is successful in that it allows younger designers the experience of possible physical limitations experienced as people age. This allows designers to empathise with older people through actual experience. It is important to empathise with the user in order to understand their emotions and possible frustrations with their built environment. Fulton Suri describes four ways of understanding the user in empathic design ranging from most objective to most subjective:

1. Learn from information from secondary sources and own material, such as ergonomics data related to fitness equipment.
2. People observed in their own context, such as observing active elderly using fitness equipment.
3. People asked to join in, for example by describing the atmosphere in gym
4. Designers personal involvement by joining in the experience; such as embedding themselves in a gym and carrying out exercise routines.

(adapted from Fulton Suri, 2003b)

The fourth and most subjective process is made possible with tools such as the Mobilistrictor. Without such a suit the designer could not experience the physical and mobility limitations often brought on by old age.

6.3 Participatory Design

Where the previous two sections have dealt with gaining an understanding of the general needs of the ageing population, user involvement can uncover personal and more in-depth needs of the users. The chosen method of user involvement in this research was Participatory Design.

Participatory design involves the user in the design process. There are different degrees of participation each with a different design goal (Table 2). Users may be involved as a development panel, in which they give feedback and evaluate aspects of the designed product, service or brand. Users can also partake in in-home placement whereby they give feedback on a products usability (Laurel, 2003: 28). Both these forms of participation entail user involvement at later stages of the design process. Here the potential user merely comments on an existing product. By involving the user right from the start of the process innovation is more likely to take place. This is because the design is based on real experiences and emotions, not preconceived notions of what the user needs.

Table 2. Participation "as a means" compared to "as an end" (adapted from Kumar, 2002, in Theron, 2005: 117)

Participation as a means	Participation as an end
Implies the use of participation to achieve some predetermined goal or objective.	Attempts to empower people to participate in their own development more meaningfully.
Attempts to utilise existing resources in order to achieve the objective of programmes/ projects.	Attempts to ensure the increased role of people in development initiatives.
Emphasises achieving the objective rather than the act of participation itself.	Focuses on improving the ability of the people to participate rather than just achieving the predetermined objectives of the project.
Participation is generally short term.	Participation is a long term process.
Participation as a means, therefore, appears to be a passive form of participation.	Participation as an end is relatively more active and dynamic than participation as a means.

6.4 Identification of a Suitable Participatory Design Model

The USAP design model is more akin to the concept of *participation as an end* as elaborated in Table 2.

Although the USAP design model has unique benefits to those involved, it also offers challenges to the designer. Users are usually involved in the design process on a consultancy basis. This inclusion usually takes the form of either:

> A *Development panel*, whereby "groups of people are contracted over a period of time to evaluate and give feedback on various aspects of a product or service as it's developed" or,
>
> *In-home placement* in which "people are given a product or provided with a service at an early stage of its final development and asked to use it as a part of their daily lives and then provide specific feedback on how it performs" (Ireland, 2003:28).

The USAP design model however includes users from the outset of the design project; the concept generation phase.

The USAP design model is inherently an empathic design model as it is:

i. User-centred – demands contact with the real user.
ii. Visual and tangible – thus supporting designerly thinking.
iii. Cheap and low-tech – thus easily adaptable.
iv. Subject to interpretation – because designers will have to understand how the users look at themselves, and what is meaningful.
v. Playful and pleasant – in order to inspire the users to imagine future experiences.
vi. Includes potential users at the start of the design process – concept generation

(Ilpo Koskinen, 2003)

This model for design gives the potential users of the product a great amount of influence in shaping the project. On the other hand, because the designer relinquishes the general position of expert and hands over direction to the participants, (the designer wields less control than they would have in an ordinary design process) there is a certain lack of control of the project.

7. Application of the USAP Design Model

7.1 The Design Process

Design processes vary according to the designers needs and are made to suit the context for which they are designing. Having a process helps designers ground creative thought. Design processes allow designers to plan a project and define the procedures that will be used to fully realise a design project. This project-oriented approach to design is thus usually linear (Viscocky O'Grady, 2006: 67), with a beginning and end. The grounding of the design process allows the designer to work in the variables that relate to that specific project. The basic design process on which different variations are based follows the linear structure of: Brief → Research → Concept Development →Prototype → Production →Delivery. Participation by users usually happens in the concept development stage. This participation is generally based around a specific product chosen to be developed by the designer. The participants then offer suggestions which are used to improve the compatibility of that product to their own needs.

The inclusion of user's right from the beginning of the design process offers more chance for innovation. This is because the users act as a client (often secondary) and their participation can lead to the exposure of real world needs that might not have been perceived by the designer. This inclusion thus allows users to decide on the design direction.

As the elderly are the primary users within this project it was important to include representatives into the design process. The chosen participatory design model was the USAP design model as it was developed with the elderly as its focus, and because it included these users from the beginning of the design process.

The USAP Model has been modified here to include a transgenerational audit as well as add iteration to the Concept Development Phase; indicated in red.

The introduction of a transgenerational audit ensures that the products produced by using this model appeal to younger users/ consumers as well as the elderly. The iteration in the Concept Refinement phase will limited by individual project deadlines and time spent in this phase is not specified.

Iteration does however increase dialogue between the participants and the designer, and allows designs to be revisited until a satisfactory outcome is reached.

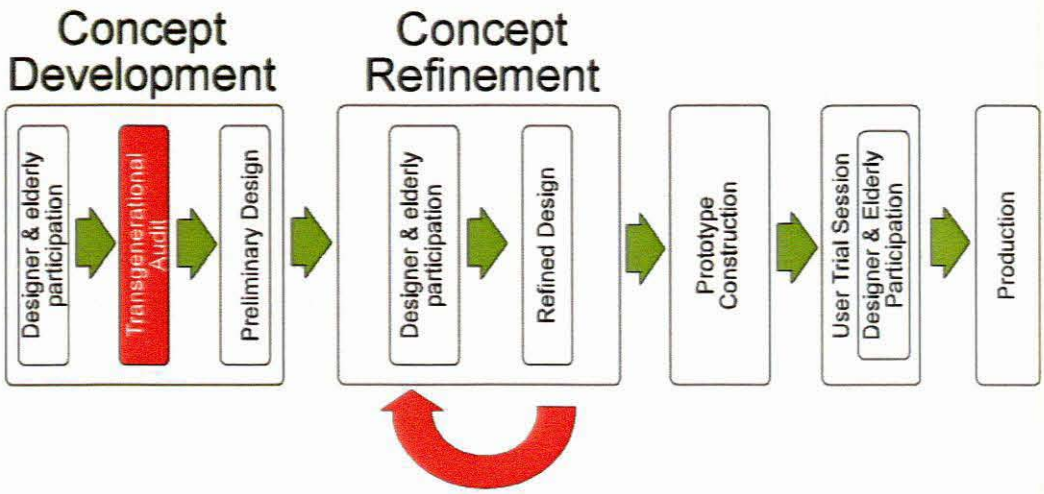

Figure 18:Modified USAP design model

7.2 The Usability, Safety and Attractiveness Participatory (USAP) Design Model

This chapter will describe the different phases of the USAP design process and their resultant outcomes. It will also describe the efficacy of the model in the field of Inclusive Fitness and the design of exercise related products for the active elderly.

7.2.1 Participating Users

Three main groups of participants (Table 3) were setup to conceptualize and design products relating to the exercise needs of the ageing population. These groups were made up of people of different ages and different abilities. Although the main focus was on the needs of the elderly, people at different stages of ageing were included in order to produce a fitness product with transgenerational appeal. The inclusion of younger participants took place

after each PD workshop involving older potential end-users. The young participants evaluated the findings from the design sessions with the older participants, and suggested ways in which to make the elderly participants ideas more transgenerational in appeal. The three groups were involved at different stages of the design process.

Although each group differed in fitness exercises and age, some similarities between the groups were maintained. Each group consisted of 4-8 participants with males and females representing the demographic of the general population. This sample size is recommended for the application of the USAP design model (Figure 18). The participants were based in Cape Town, in the Western Cape.

The different characteristics of the three groups impacted on the design process. Groups 2 & 3 were more open and immediate in their responses as the participants knew each other prior to the formation (existing group) of PD workshops.

Table 3: Different characteristics of the 3 groups

Group 1 *Active Elderly*	Group 2 *Average Elderly*	Group 3 *Tomorrows Elderly*
Average age of 61	Average age of 70	Average age of 50
50% male, 50% female	30% male, 70% female	50% male, 50% female
Formed group	Existing group	Existing group
Involved in rehabilitative fitness programs	Exercise levels ranged from minimal to average	Engaged in active lifestyle
Involved in Concept Development phase	Involved in Concept Development phase	Involved in Concept Refinement phase

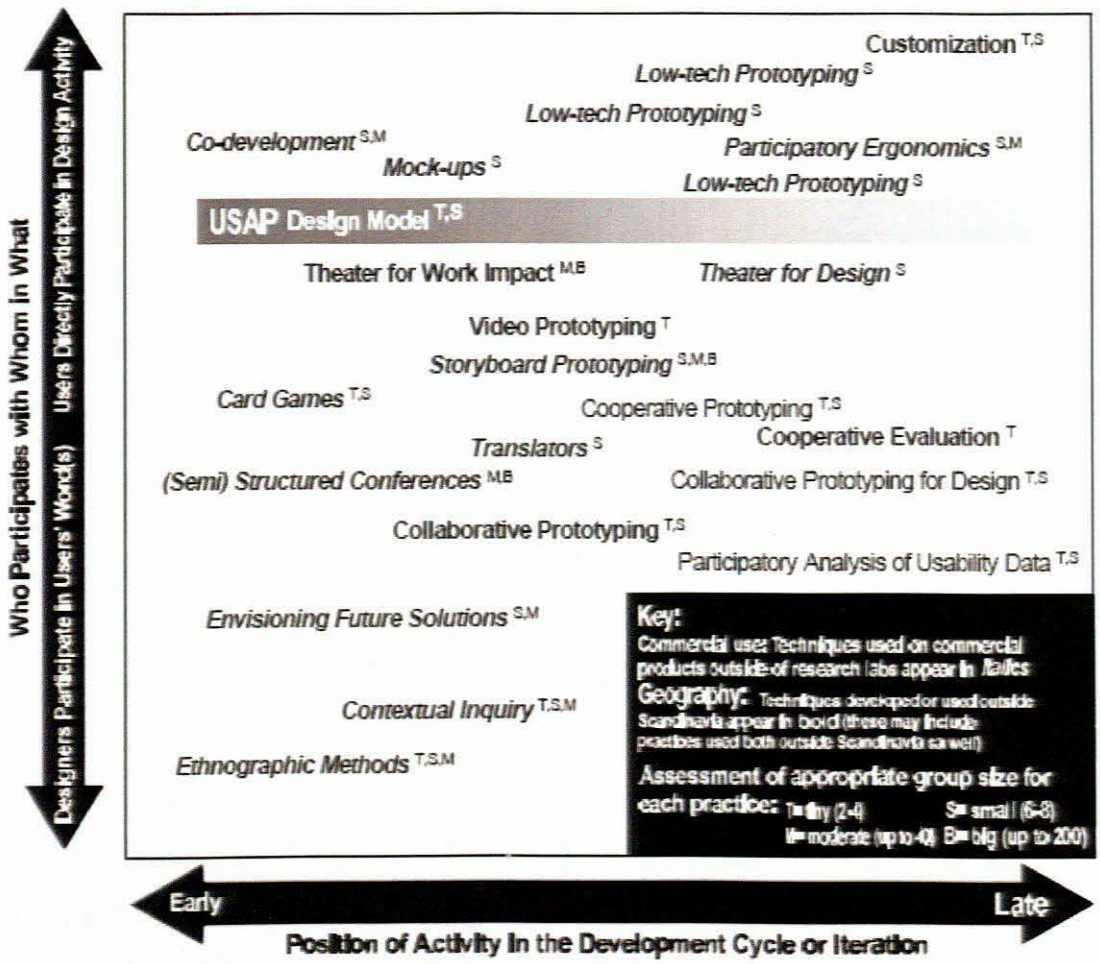

Figure 19: Placement of USAP design model showing recommended group size

7.2.2 Phase 1: Concept Development

The first PD session

The first PD session was held in the HPL of the Department Of Sport Management, CPUT. There were a number of active elderly present. The session began with introductions and was followed by a presentation which outlined the following:

Who we were: a multidisciplinary team working toward inclusive fitness solutions;

Our aims: inclusive fitness equipment developed through a user-centred approach of co-creation;

Definition and justification of PD

How participants could help: problem identification, major input into the design process and usability testing.

This presentation was then followed by a discussion on various issues raised by the people present. After the discussion they decided whether they wanted to participate. This resulted in a small group of dedicated participants volunteering their knowledge toward the common goal of inclusive fitness.

The rest of the session involved a tour around the HPE where participants voiced their opinions about the equipment and environment. Recording of this data was done through note-taking and audio recording.

Individual Sessions

During these sessions the focus was on the needs of the participants regarding fitness equipment. These sessions made use of both unstructured interviews and a card game developed by the author called the *Human Factors Card Game* (Figure 19). This game is a research tool which enables the user to express their feelings about a large range of design inputs in a short amount of time. It is interactive and encourages the user to express their needs in their own words. The game focuses on three core, interrelated aspects of design: *User, Product* and *Environment*. The cards are colour coded blue, red and green respectively.

aspects of design: *User, Product* and *Environment.* The cards are colour coded blue, red and green respectively.

Figure 15: Human factors Card Game

Each side of the card has a specific purpose. The front has a word related to that field, while the back has space for the player to write their comments and opinions, should they wish. This game is adaptable for use with people of different languages as it can be printed in a specific language. For this research English was used as this was the preferred language of the participants. The words relating to each theme were drawn from ergonomics data and social themes pertaining to the needs of elderly populations. Samples of the results can be found in Annexure 1. Each participant performed the game in the same manner (Figure 20). The location was the HPL, CPUT and was carried out after their exercise routine. These sessions were overseen and verified by a non-participant observer experienced in the field of design research and practice. The duration of these task-oriented interviews were approximately 45 minutes and is based on other participatory interviews (Haines, 2002).

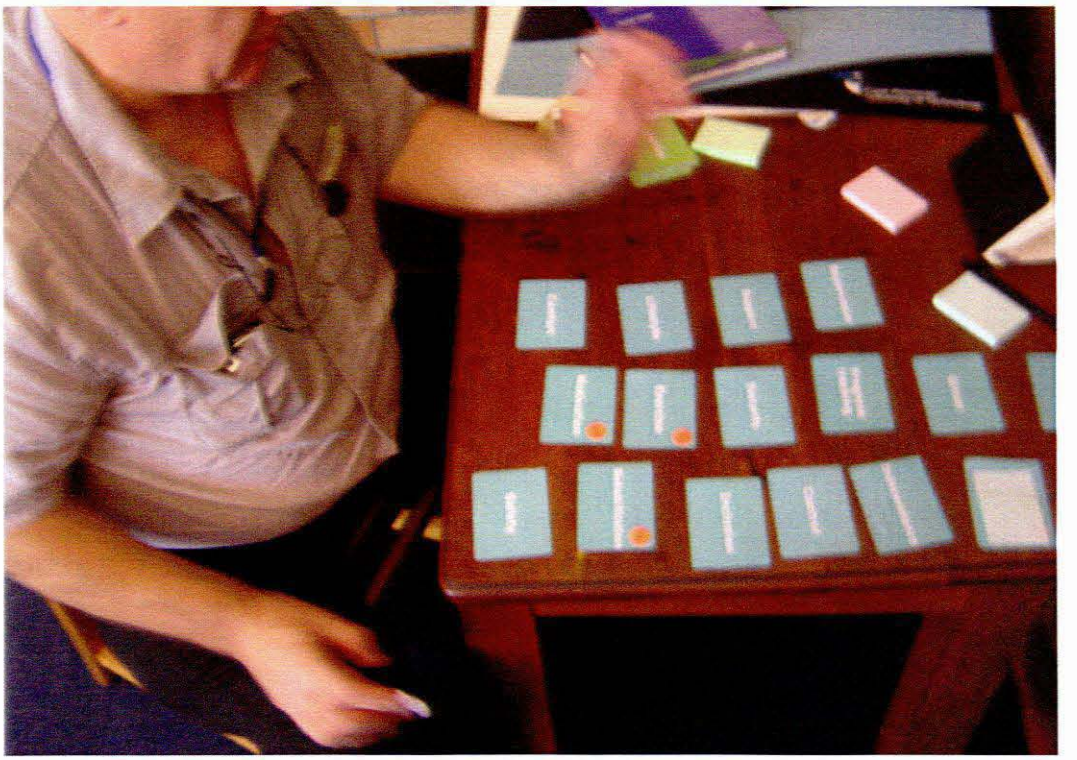

Figure 6: A participant from group 1 using the Human Factors Card Game

The participants had fifteen stickers, five per category. These were used to mark aspects of design they felt to be the most important. The results from these sessions were collated and organised into three degrees of importance (Table 4). These were: *most important; moderately important;* and *less important* (Demirbilek, 1999:93). This was done by correlating participants choices in the following manner: aspects chosen by all users were defined as most important; aspects marked as important by users but which were not similar across the board are labelled moderate importance and those cards which users commented on but did not label as important were categorized as less important. (Futerman & M'Rithaa, 2007:135). These findings were interesting as the participant's responses were very similar. There was a strong correlation between the needs of older participants and those of the younger participant. From this it is suggested that the needs of young, disabled people is similar to those of older people regarding fitness equipment. The results present a concise list of user's needs to be addressed (Table 4).

Table 4: Classification of design requirements relating to active living

	Most important design requirements are related to:	Moderately important design requirements are related to:	Less important design requirements are related to:
PERSONAL	**Motivation** **Rehabilitation** **Privacy**	Exercise Supervision Progress Tracking Lifestyle	Safety Inclusion Group Independence Comfort Control Support Opportunity Security
PRODUCT	**Effectiveness** **Satisfaction** **Efficiency** **Convenience**	Learnability Aesthetics - audio	Tolerance for Error Feedback Safety Equitable use Appropriate Physical Effort Control Performance Adjustability Simple & Intuitive Access / Egress Range of movement Flexibility in use Adaptability Perceptible information Range of resistance Programmable Responsiveness Legibility
ENVIRONMENT	**Accessibility** **Encouraging**	Functional Safety Outdoors Mirrors Sound Colour	Efficiency Comfort Furnishings At home Intuitive Gym Lighting Indoors Responsive

The main user needs arising from these sessions are as follows:

- Fitness equipment must be appropriate for rehabilitative exercise,
- A level of privacy must be addressed,
- It must offer encouragement and motivation to the user,
- Equipment and the environment in which it is used must be accessible to a variety of users,
- There should be a form of supervision,
- Progress tracking is important, and
- Equipment must be compatible with user's lifestyle.

Other recommendations by the participants relating to the three focal areas included:

User/ personal

- People should be able to progress naturally from rehabilitation based exercise to mainstream gym use. Therefore integration of the two is important,
- There should be the option of group participation, as this can provide motivation,
- Independent use of equipment with the option of assistance,
- Preference for exercising away from home for motivational reasons.

Environmental

- The need for exercise equipment to combine different routines such as cardiovascular and strength,
- Mirrors or reflective surface to check posture,
- Choice of indoors or outdoors,
- Modern, less clinical aesthetics,
- Intuitive route, i.e. progression from one piece of equipment to the next,
- Location of 'gym' in shopping complex to allow users to perform other tasks, i.e. a one stop shop,
- Uplifting colours,
- Accessibility to extend beyond 'gym' to amenities such as bathrooms.

Product

- Must be adaptable to personal/ changing needs,
- Affordances for personal limitations,
- Personalized features such as sound and colour,
- Reduce size of current equipment,
- Improved legibility through diagrams as opposed to text,
- Monitor users health by means of heart rate, check for over-exertion,
- An exercise station such as jungle gym combining different exercise routines,
- Feedback and progress reports via swipe card.

One of the main concerns was motivation. Both young and older participants preferred interaction with a trainer as a preferred form of motivation. Progress tracking was more important to participants involved in rehabilitative exercise as they have personal fitness goals. The participants felt that exercise was generally incompatible to their lifestyle, and expressed how it was an activity that they had to find time for due to this. It is therefore important to match inclusive fitness products to the lifestyles of older users. Walking is the preferred form of exercise amongst the elderly; therefore the product should be compatible with this.

7.2.3 The Second PD Session

Findings from the first phase of participation were compiled to form a questionnaire which was used to validate initial findings through a wider audience; and identify possible ways in which to implement these findings. This questionnaire was the final stage of phase one. As with the previous sessions the questionnaire was given to younger participants as well for transgenerational evaluation. The questionnaire also engaged people who had not previously been a part of the project. People from a retirement village (Group 2) were asked to fill it out.

The respondents totalled 9 individuals and were made up of predominantly women at 70%. Ages ranged from 59 to 80 years of age with an average chronological age of 70. Results from the first part of the questionnaire are presented in Table 5.

Table 5: Findings from questionnaire

Section 1	Strongly Agree				Strongly Disagree
Fitness equipment must be appropriate for **rehabilitative exercise**	**8**	2	1		
A level of **privacy** must be addressed	**6**	5			
It must offer **encouragement** and **motivation** to the user	10	1			
Equipment and the environment in which it is used must be **accessible** to a variety of users	**8**	2		1	
There should be a form of **supervision**	**8**	2	1		
Progress tracking is important	**8**	3			
Equipment must be compatible with user's **lifestyle**	**7**	3	1		

The results to Section 1 of the questionnaire corroborate previous findings. The strongest point of agreement being the need for encouragement and motivation. The preferred form of motivation is exercising in groups. Respondents stated that interaction with other people during exercise encouraged them to keep going and made exercise more fun.

Section 2 of the questionnaire focussed on ways to implement the above statements, while Section 3 contained questions relating to exercise. The preferred form of exercise amongst the respondents was walking (Figure 21).

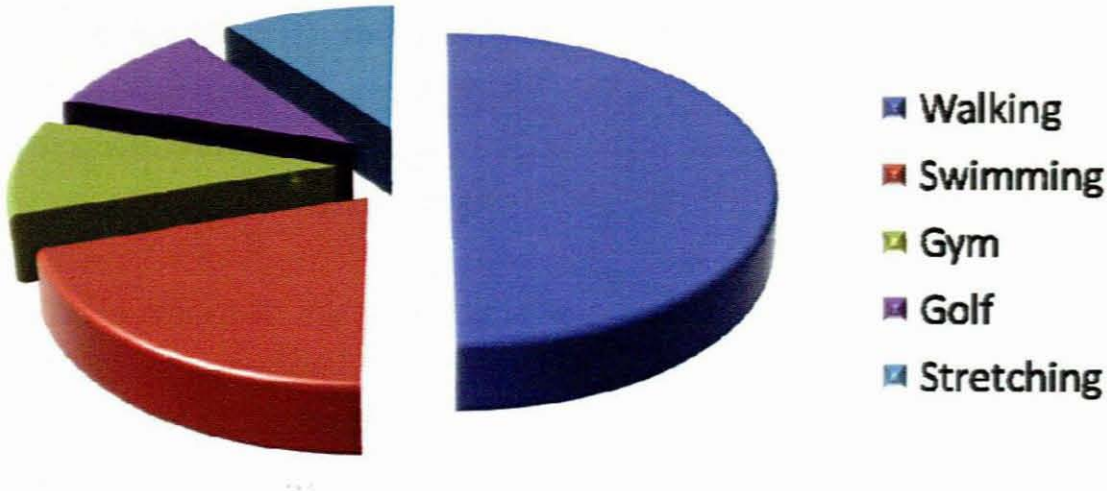

Figure 21: Preferred form of exercise amongst elderly participants

This supports international research which shows the same. Most respondents also exercised solely for health reasons and not because they wanted to.

The results from the questionnaires therefore resulted in the following user requirements:

- Design should be based around walking,
- It should cater for and encourage group interaction, and
- Progress tracking should be simple.

The results from this PD session provided specific design requirements for exercise equipment relating to South Africa's older population.

Questionnaires were also given to two younger gym users for a transgenerational audit. The young respondent's main requirements were the same as the elderly participants. These were motivation and progress tracking. The young respondents also had a preference for group exercise as a motivator.

In conclusion the PD sessions revealed that motivation is the main inhibitor when it comes to exercise, however this can be reduced if fitness products are suited to group exercise. Also, people involved in a fitness routine are

concerned with their progress. Positive progress can also act as a motivator as people can see an improvement in their health.

7.3 Concept Development

7.3.1 List of Requirements

This list is broken up into u*ser needs*, identified through participatory design sessions and questionnaires; and *general requirements*, collected from desktop research into recommendations for exercising adults; and *equipment requirements* from desktop research into inclusive fitness equipment and evaluations of existing exercise trails and outdoor fitness equipment. The list of design requirements is as follows:

User needs:	Progress tracking, Suitable for group exercise, Based in walking, Suit progression from rehabilitation to mainstream use, Provide a form of supervision, Adequate privacy,
General requirements:	Encompass resistance, cardiovascular, stretching & balance exercises, Monitor user's heart rate and provide necessary responses, Safety, Incorporate elements of Sustainable design,

7.3.2 Conceptual Designs

The user requirements led to three main concept directions (Figures 22 -28). These concepts were then discussed with participants in the *Concept Refinement* phase of the USAP model (Group 3). The following concepts are all aimed at improving fitness equipment for the elderly and include facilities, exercise equipment, and tools. The concepts are based in the realm of walking as this was found to be the preferred fitness activity. All concepts are in the preliminary stage of design and were used to offer possible design directions to the participants.

Figures 22 & 23 present the idea of a fitness trail, whereby people can build on their walking routine by using available equipment to perform other exercises which include balance, resistance, cardiovascular and stretching. The equipment is designed to be inclusive, transgenerational and encourage group exercise, which this research has shown is an important motivator for people of all ages. The basic route will take approximately half an hour to complete, which is the recommended minimum time a person should exercise every day.

After evaluating existing equipment the following shortcomings have been identified:

- Lack of transgenerational accommodation,
- Focus purely on areas of interaction points, not paths between them or incorporated needs such as drinking fountains,
- Lack of progress tracking,
- Privacy not addressed,
- Exercise trails limited to outdoor use,
- Users generally face the equipment and not at view/ surroundings,
- Users not able to perform floor exercises.

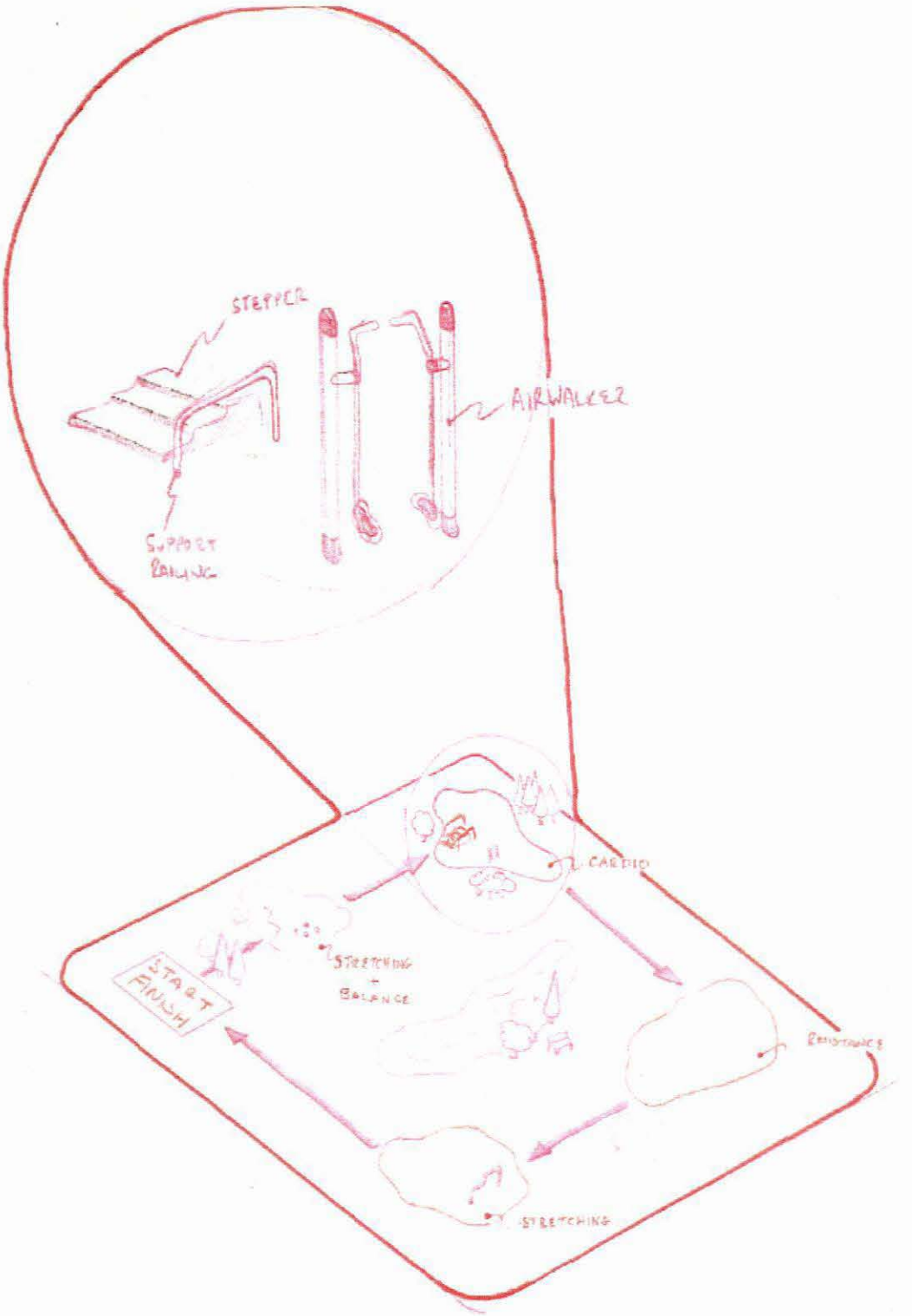

Figure 7: Outdoor fitness trail concept

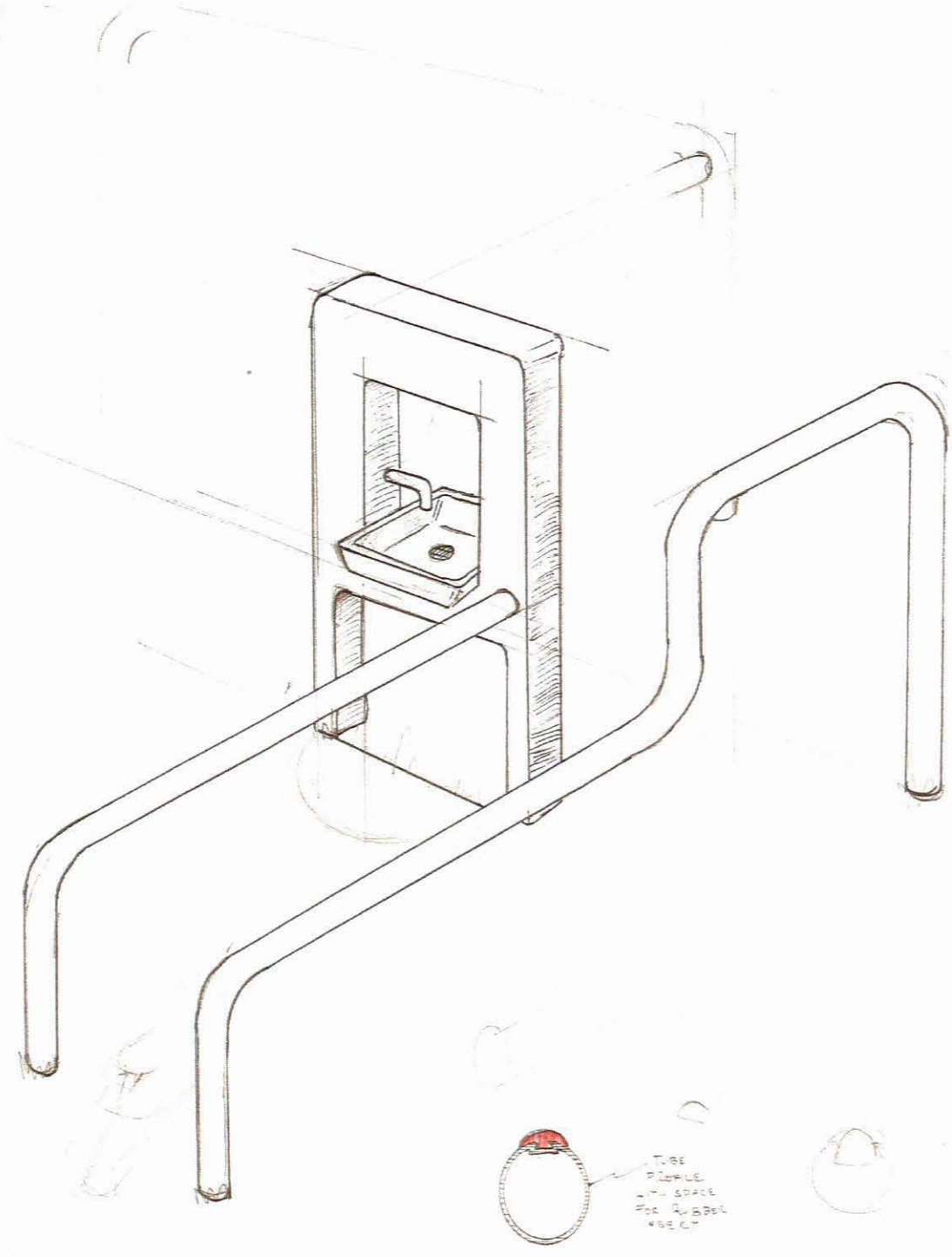

Figure 23: A piece of equipment incorporating a drinking fountain

Figure 22 presents a possible layout of the fitness trail in the form of a closed circuit. Based in an accessible environment, the exercise trail would guide people through different exercise hubs. At each one of these points the person has the option to perform a specific type of exercise, be it cardiovascular, strength, stretching or balance. Figure 23 shows a possible piece of equipment which could be used for stretching or rehabilitating people who have temporary injuries and use a wheelchair. The facilities therefore also have to be accessible, and thus the water fountain is usable by people in wheelchairs. All equipment is designed to take into account multiple users such as the primary user as well as a personal trainer.

Figures 24 – 27 present the concept of a 'smart shoe.' Preventing falls amongst the elderly is very important as in some countries they are the most common cause of fatal injuries. A recent study stated that in 70 percent of elderly fall cases they were wearing athletic, oxfords or loafers (Brody, 1998). Dr Frey, the researcher responsible for this study, amongst other experts recommends the following shoe safety guidelines:

- Avoid shoes with slippery or worn soles, especially smooth leather or plastic soles.
- Avoid shoes with heavy rubber lugs, and rubber tipped athletic shoes as they can catch on carpets.
- Walking shoes with good traction, light soles and support are recommended.
- Avoid shoes with too much cushioning, as they can make an older person unstable.
- Shoes that lace up or can be adjusted are better than slip-ons. (Brody, 1998).

The goal of the smart shoe is thus twofold. Firstly, to provide older wearers with a sturdy shoe that will decrease their chances of falling; and secondly to monitor exercise habits.

The miniaturization of technology allows for the inclusion of a pedometer, heart rate monitor and other related devices. By including wireless or

Bluetooth technology the user will be able to track their progress and keep track of their distances walked via their personal computer (PC).
Shoes would use Velcro or another fastening system which does not require fine motor skills, which is the case with shoe laces.

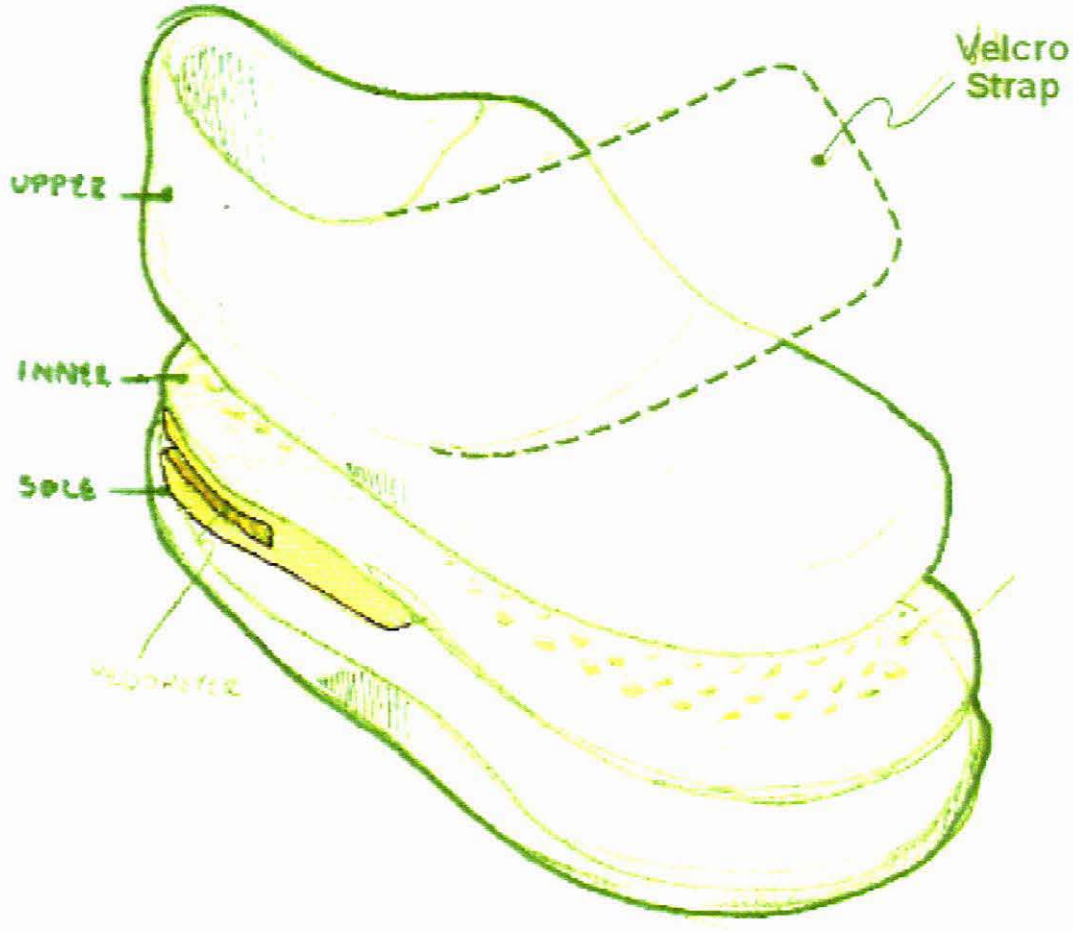

Figure 24: Preliminary sketch for smart shoe concept

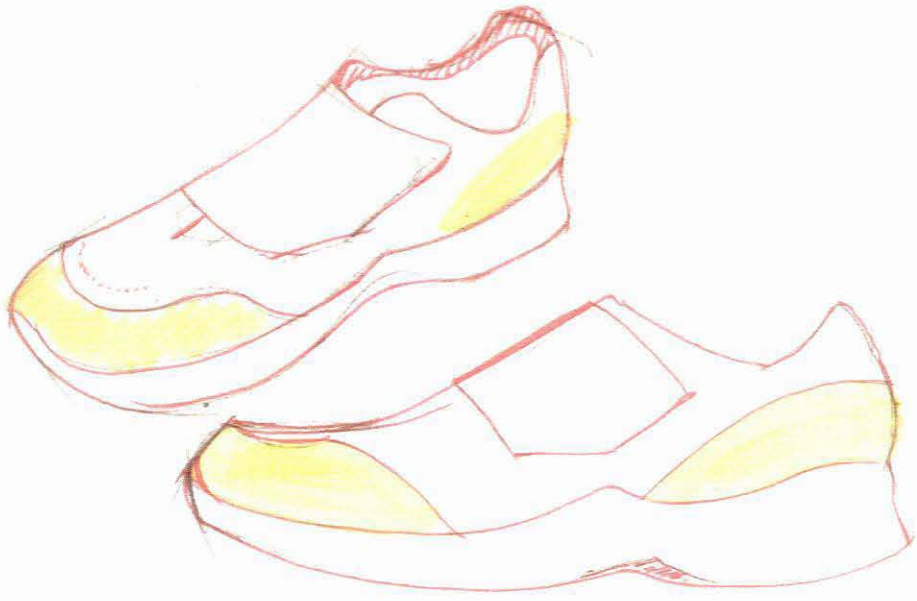

Figure 25: Athletic smart shoe concept

Figure 26: Casual smart shoe concept

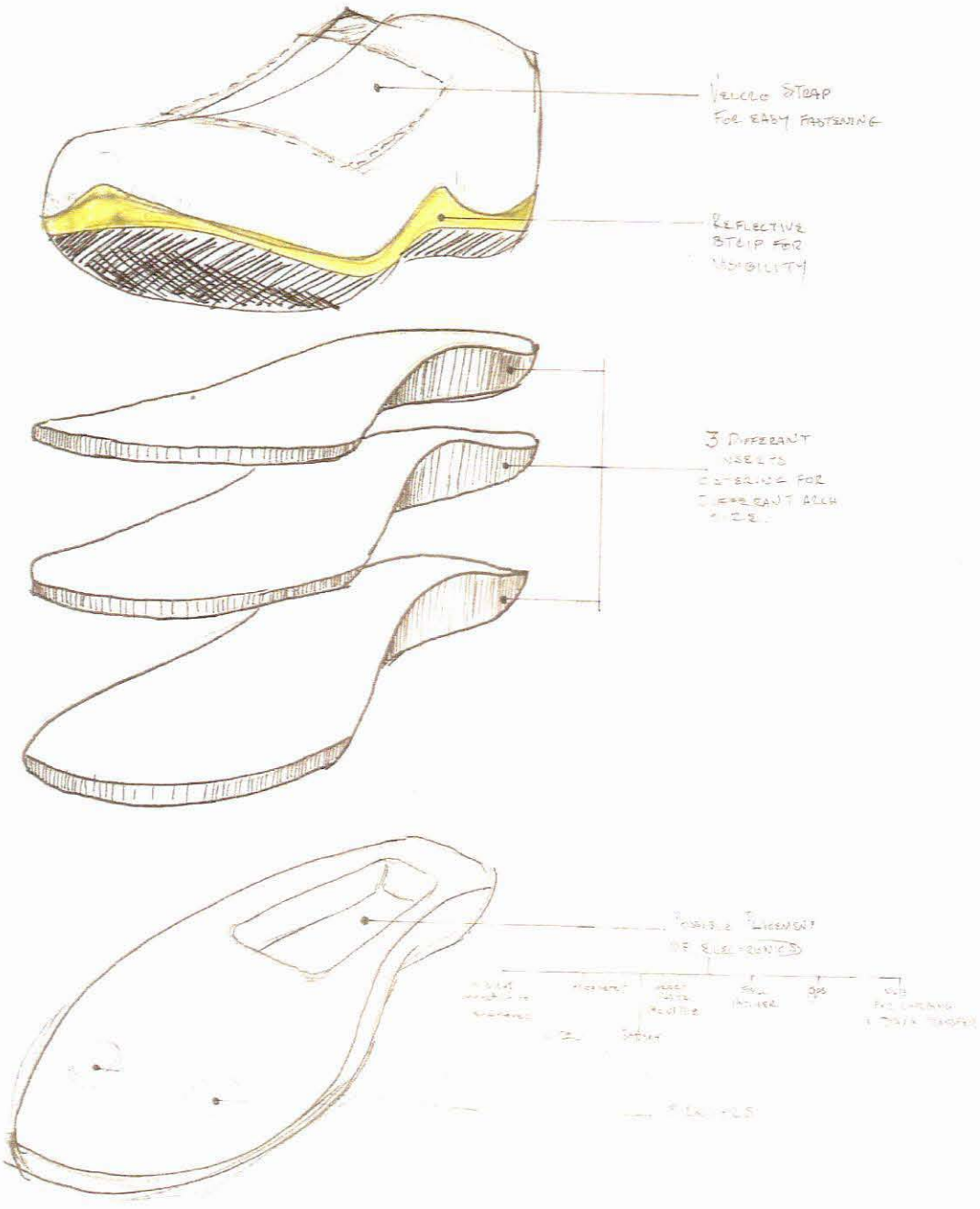

Figure 27: Smart shoe concept showing different inserts and space for technology

Figure 28 presents the concept of an exercise watch. This concept is similar technologically to the 'smart shoe', the main difference being how a person interacts with the technology. Here the technology would not be as invisible as in the smart shoe, but presented in an interactive format. As with the shoe fastening the fastening system would need to take into account diminishing fine motor skills and age related limitations such as arthritis. Different functions would be shown via the watch face in the form of pictograms. This would do away with language barriers.

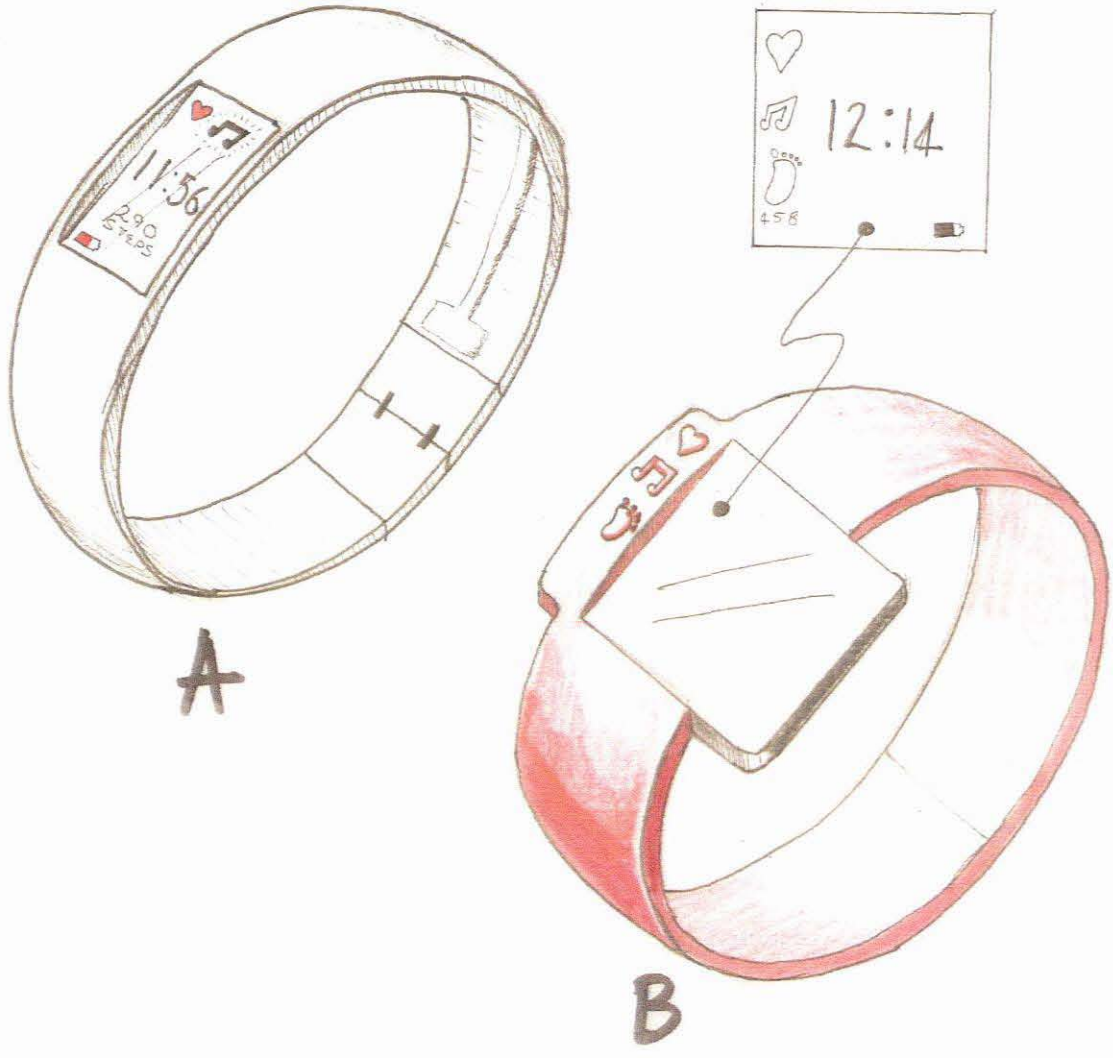

Figure 28: Exercise watch

7.3.3 The Third PD Session

This session was part of the concept refinement phase of the USAP design model. The purpose of this session was to evaluate the different concepts and choose one for further development. Group 3 were involved in the development of the refined design. They were presented with concept sketches which to evaluate and comment on. The ideas behind each concept were explained to the participants, such as the technologies incorporated into the designs. An example of a participant's input can be seen in figure 29. The role of the designer during this session was as an impartial moderator, while the participants play the jury and criticize the drawings, making notes and sketches directly onto the concept renderings. The session lasted half an hour

The participant's statements concerning the three concepts were as follows:

- Fitness Trail
    - Vandalism – materials need to be without resale value,
    - Need for lockers,
    - Preference for outside location along existing paths,
    - Safety.
- Smart Shoe
    - Preferred concept for development,
    - Easy integration into lifestyle,
    - A preference to link shoe technology to emergency response (Family or Outside company),
    - The need to accommodate swelling, bunions and other conditions experienced,
    - Ventilation important,
    - Multipurpose use,
    - Reflexology points incorporated,
    - Key storage
    - Smell

- Exercise Watch
    - Concerned it will interfere with movement during exercise
    - Smell

The 'smart shoe' was chosen to be the preferred concept for immediate attention. The participants felt it was a much needed product and saw benefits for its use outside of the fitness realm as well. They felt it could be easily incorporated into their lifestyle, as it is an everyday product.

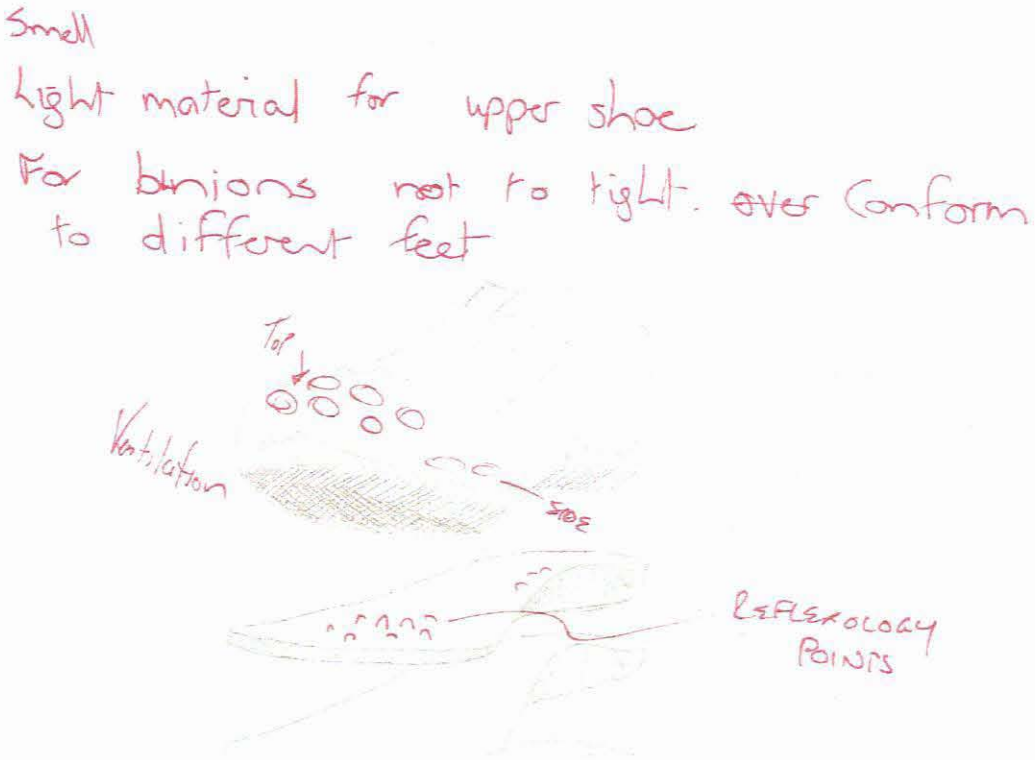

Figure 29: A participant's comments and ideas regarding the 'smart shoe' concept

8. The Final Design

The participants chose the 'smart shoe' concept to take further. The following section presents a possible solution (Figures 30 & 31) and its relevance to the ageing population's fitness needs.

The PD sessions presented a list of requirements for the design of fitness related products. The product had to:

- Motivate and encourage the user,
- Be usable in group exercise,
- Easily integrated into the user's lifestyle,
- Suit future generations of elderly users,
- Have transgenerational appeal,
- Be able to track the users fitness progress, and
- Be suited to walking and other preferred forms of exercise and recreational activities.

These requirements were combined with the specific needs related to the smart shoe concept during the third PD session.

Figure 8: The 'smart shoe' concept

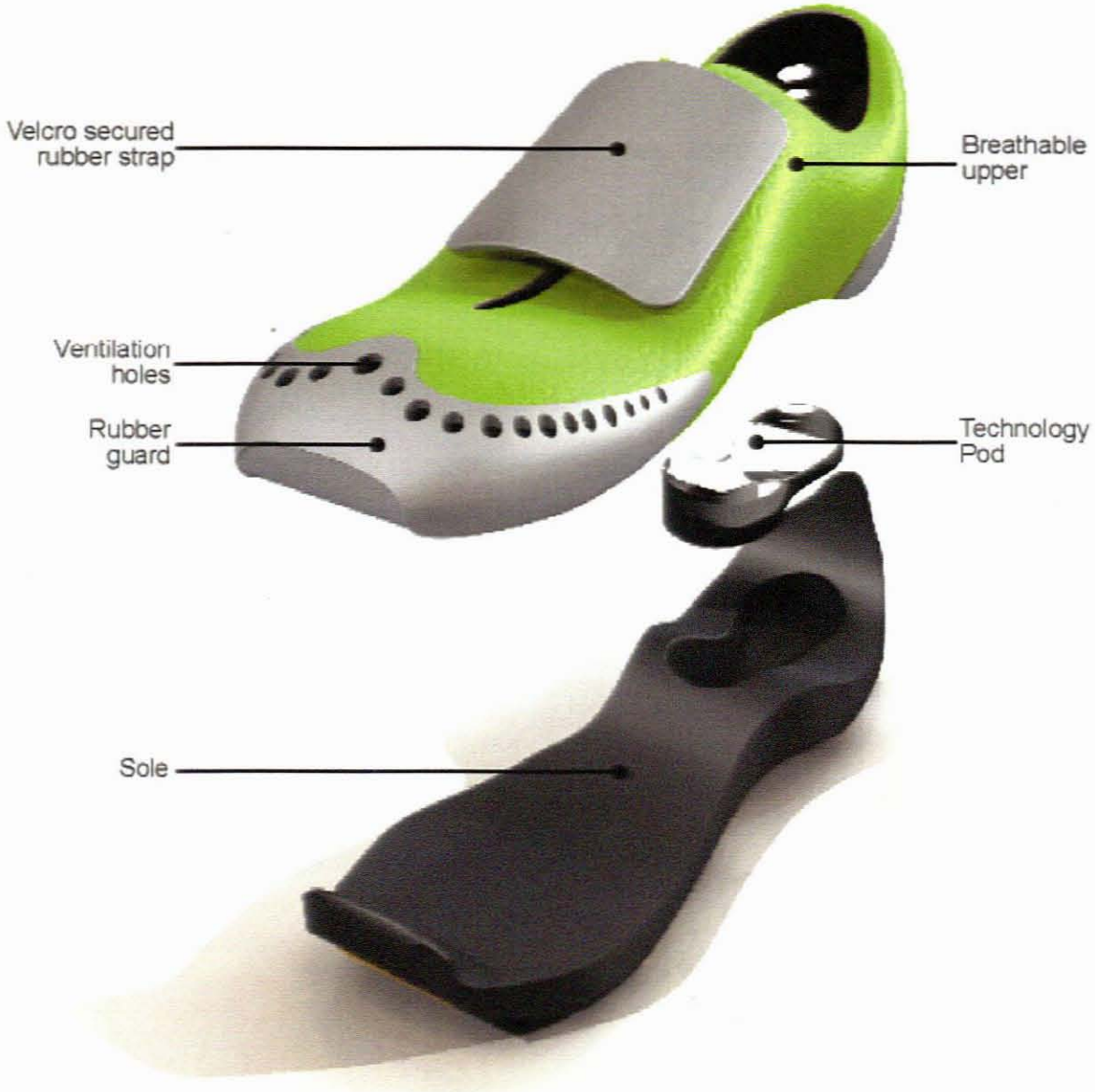

Figure 31: Exploded view showing different parts

Shoe Upper

This will be manufactured from hemp. Hemp provides warmth and breathability in a superior combination than cotton and most other fabrics. The fibre structure allows it to wick moisture off the body as well as dry quickly reducing foul odours often associated with shoes. Hemp also has good antibacterial properties.

Tongue

The tongue is manufactured from Hemp. The operation of the technology pod is controlled from here via a conductive thread sewn into tongue. An example of this 'smart fabric' process is shown in Figure 33. To operate, the user touches and holds their finger on the required function key for three seconds. This prevents accidental operation. The buttons available will depend on what technology the user has opted for.

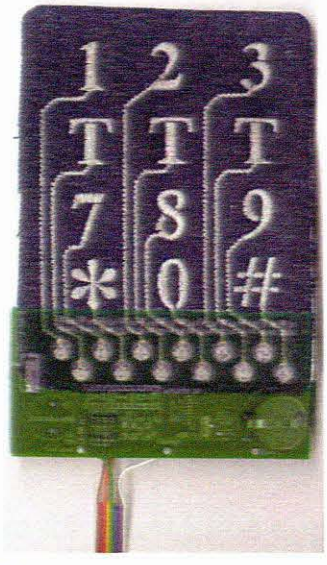

Figure 33: All-fabric capacitive keyboard.

Implementation

People will be able to order the shoe that meets their specific requirements. This will be done via a website. Here the customer will be able to select colours, graphics, size, sole type and technology to be incorporated. Users

will be able to customize their shoe to suit their personal requirements such as:

- Intended use, and
- Features needed.

Customers can therefore purchase a shoe that meets their specific cost and usage needs. The shoe meets the needs of multiple age groups and their characteristics. Models include golf shoes (figure 34), general purpose shoes and collector graphic options aimed at younger customers. The graphics can be done in collaboration with current artists and illustrators in limited runs and form collectors editions. This is possible due to current printing technologies. Vans™ Shoe Company manages a similar website which allows potential buyers to colour code their shoes.

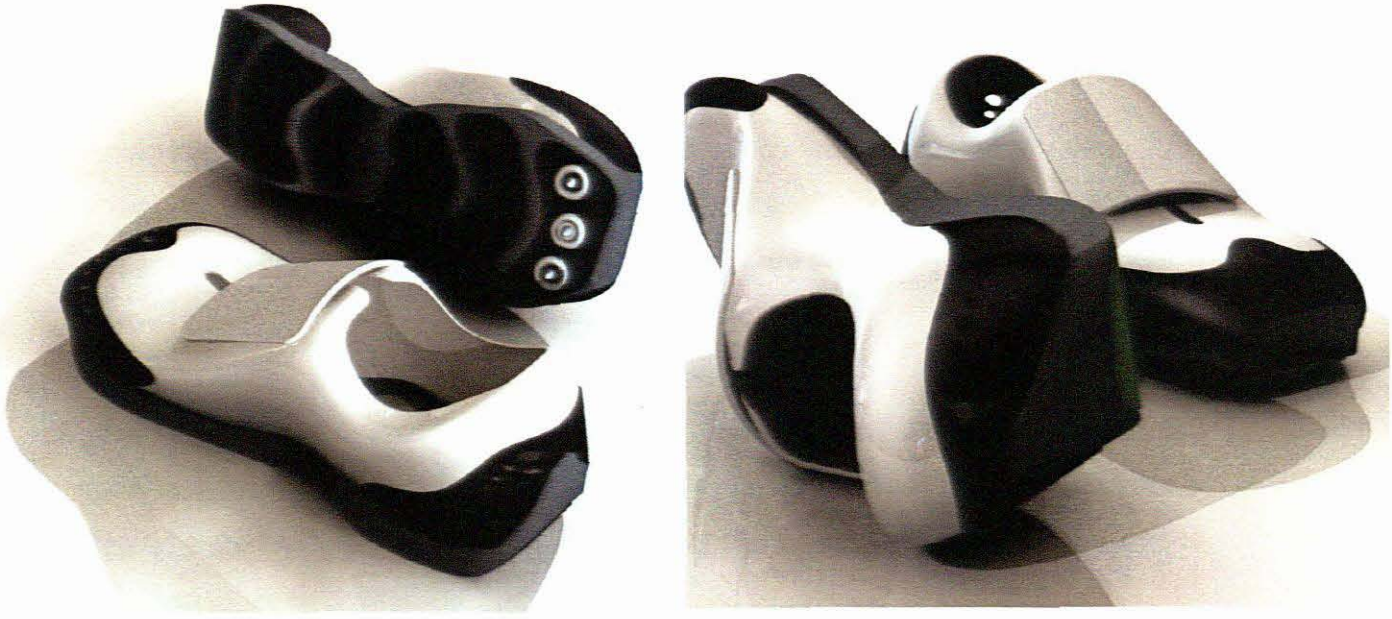

Figure 34: Golf Shoe option

The 'smart shoe' is a concept which has been investigated from university research labs to major sport brands. Currently the following technologies are being investigated for inclusion in 'smart shoes':

- Sensors for physiological, motion and force readings,
- Wireless transmitters,
- Pedometers,
- GPS,
- Expandable polymer gel, and
- Magnetic sensing system.

These technologies create the opportunity for the wearer to monitor weight, walking patterns, location, amount of steps taken in a specific time frame, and can automatically adjust to the users motion needs whether they be walking or running. By including sensors that check pressure points and automatically adjust the shoe for even pressure along the foot surface, 'smart shoes' could eliminate most hip and knee replacement surgery (Frey, 2007).

Adidas™ released a 'smart shoe' in 2005 which was a major success. The shoe, aimed at runners, constantly adjusts its shock-absorbing properties, depending on the users running style, pace, body weight and running surface (David, 2005).

The idea of 'smart shoes' have not really been investigated in relation to the ageing populations needs and are usually purpose designed sports shoes. The concept offered here aims at meeting the needs of this segment of the population as well as other age groups.

The Shoe is made up of the following parts:

- The outer sole,
- Inner sole,
- Technology pod,
- Upper, and
- Tongue.

The Outer Sole

The outer sole is to be made from a Closed Cell Resin (CCR). This material has inherent qualities perfectly suited in the manufacture of shoes and is currently used by a number of major shoe brands. It has the following qualities:

- Warms and softens from body heat and therefore moulds to the wearers foot,
- As it is closed-cell it is anti-microbial and resistant to odour causing bacteria and fungus,
- Slip resistant,
- Suitable to moulding processes,
- Waterproof,
- Can be produced in a number of colours.

Inner Sole

The inner sole is where the base of the foot comes into contact with the shoe. The shape of the inner sole is a large determining factor in a shoes comfort. This part is also made from CCR. It will be made in three shapes to accommodate varying foot arches. It will have a textured surface and incorporate reflexology points.

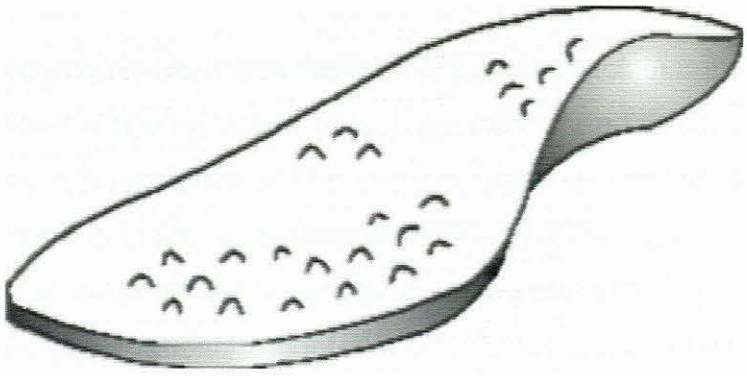

Figure 32: Inner Sole

Technology Pod

The technology pod incorporates a number of miniaturised technologies, electronics and sensors. The customer will determine what technologies will be incorporated into the pod, as their needs will be different (see Implementation pg 70)

Most of the technology is under development at present making it difficult to specify exact sizes; however it is being developed for use in shoes.

The following options will be available:

- Wireless transmitter – used to transfer data to computer for progress tracking; and make it possible to use wireless headphones which are more suited to exercise,
- Sensors – for physiological, motion and force readings,
- GPS – to track the users walking routes,
- 3 axis Accelerometer – which can measure speed and distance, and determine if the wearer falls.

Standard parts will include a rechargeable Lithium-ion battery similar to those found in cell phones and micro SD card which can store up to two gigabytes of information. Recharging of the battery will take place outside of the shoe in a separate mains charger. This enables the shoe to be wholly waterproof as there are no open electrics.

9. Conclusion

The original research problem was twofold. Firstly the lack in compatibility between the needs of ageing users, fitness equipment and the environment where this interaction takes place; The second dealt with the lack of participation of ageing users in the design of fitness equipment.

The first half of the problem was investigated using qualitative research methods such as observations and interviews. The goal of this stage was to investigate both the context for which the research was focussed and to better understand participant's personal feelings about fitness. It was found that compatibility between older people and fitness products could be improved through participation.

The second part of the problem involved older people through participatory design methods. PD groups were assembled in order to allow older users a platform for making known their personal needs in the context of exercise. These PD sessions revealed that *motivation, rehabilitation* and *privacy* are the most important factors relating to design for the elderly with regard to fitness equipment. The inclusion of transgenerational audits throughout the design process improved the final design appeal to younger generations as well. This is important in order to create a more inclusive product, one that appeals to people of all ages. This inclusiveness in the field of fitness is important as it was found that both young people with disabilities and older participants have similar needs pertaining to exercise products.

By addressing the needs of the active elderly through participatory design methods, specifically the USAP design model, a variety of product concepts were generated. The concept chosen for further development was the 'smart shoe.' This 'smart shoe' aimed to meet the exercise requirements of a multigenerational population and thus not stigmatize older users.

10. BIBLIOGRAPHY

Active Ageing Australia n.d., *'Taking action for Active Ageing'.* Retrieved October 24, 2006, from http://www.activeageingsa.net.au/welcome

Clarkson, J. Coleman, R. Keates, S. Lebbon, C. (eds.), *Inclusive Design: Design for the whole population.* Great Britain: Springer. p. 30-49.

Coleman, R. 1999. Inclusive Design – Design for All. (*In* Green, W. S. & Jordan, P. W. (eds.), *Human Factors in Product Design*. London: Taylor and Francis. p. 159-170.)

Coleman, R. 2003. Living Longer. . (*In* Clarkson, J. Coleman, R. Keates, S. Lebbon, C. (eds.), *Inclusive Design: Design for the whole population.* Great Britain: Springer. p. 120-141.)

David, M. 2005. *Adidas Designs A Winner With "Smart" Running Shoes.* Retrieved 5 November 2007, from http://electronicdesign.com.

Demirbilek, O. & Demirkan, H. 2004. Universal product design involving elderly users: a participatory design model. *Applied Ergonomics,* 35: 361-370.

Demirbilek, O. & Demirkan, H. 2004. Universal product design involving elderly users: a participatory design model. *Applied Ergonomics,* 35: 361-370.

Demirbilek, O. 1999. 'Involving the elderly in the design process: A participatory design model for Usability, Safety and Attractiveness', Phd Thesis, Bilkent University. Retrieved October 22, 2006

Ehrenman, G. (2005). Fly the Greyer Skies. Mechanical Engineering Design. Retrieved June 3, 2007 from www.memagazine.org.

Etchell, L, Yelding, D. 2004. Inclusive esign: Products for all consumers. *Consumer Policy review,* 14: 186-193.

Finkelstein, V. 1980. Attitudes and Disabled People. *World Rehabilitation Fund.* London: R.A.D.A.R.

Futerman, R & M'Rithaa, M. 2007. Engaging with the elderly: a participatory approach to compatibility. *10th ESSA Conference Proceedings.* Christie, C.J. (ed) p130 – 139.

Frey, T. 2007. *Smart Shoes.* Retrieved 5 November 2007, from http://www.davinciinstitute.com.

Home Activity Monitoring System, n.d., *Barriers to Exercise.* Retrieved July 2007, from http://www.hamp.net.au/barriers_exercise.html

Huppert, F. 2003. Designing for Older Users. (*In* Clarkson, J. Coleman, R. Keates, S. Lebbon, C. (eds.), *Inclusive Design: Design for the whole population.* Great Britain: Springer. p. 30-49.)

Integrated National Disability Strategy White Paper 1997. Retrieved August 30, 2006, from http://www.info.gov.za/documents/whitepapers/index.

Ireland, C. 2003. Qualitative Methods: From Boring to Brilliant, (*In* Laurel, B. (ed), *Design Research: Methods and Perspectives.* England: Te MIT Press. P23-29.)

Johnson, P. 1993. Old Age and Ageing in Britain. *ReFRESH*, 17:5-8

Kinsella, K. & Ferreria, M. 1997. *Ageing Trends: South Africa*. Retrieved August 30, 2006, from http://www.census.gov/ipc/prod

Kroemer, Karl H. E. 2006. *"Extra-Ordinary Ergonomics"*. Santa Monica: Taylor & Francis.

Laslett, P. 1989. A fresh Map of Life: the emergence of the third age. London: Weidenfield & Nicholson.

Laurel, B. 2003. Design Research: methods and perspectives. London: MIT Press.

Participatory Design 2005. retrieved July 3, 2006, from http//:www.teched.com/ue-pd

Patton, M. (2002). Qualitative Research and Evaluation Methods. Sage Publications, USA.

Payling, J. 2003. The sense of independence. (*In* Clarkson, J. Coleman, R. Keates, S. Lebbon, C. (eds.), *Inclusive Design: Design for the whole population.* Great Britain: Springer. p. 382-401.)

Pirkl, J. 1994. *Transgenerational Design: Products for an Ageing Population*. New York: Van Nostrand Reinhold.

Pratt, Michael, M.D., et al. "Higher Direct Medical Costs Associated With Physical Inactivity." The Physician and Sportsmedicine 28(10). Oct 2000.

Preventing Obesity and Chronic Diseases Through Good Nutrition and Physical Activity. August 2003.http://www.cdc.gov/nccdphp/pe_factsheets/pe_pa.htm

Ramashala,M. (2000). Living Arrangements, Poverty and the health of Older Persons in Africa.

Report of the Second World Assembly on Ageing. 2002. New York: United Nations publication.

Ricability n.d. Inclusive Design: Products that are easy for everybody to use. Retrieved 23 September 2007 from http://www.ricability.org.uk/reports/report-design.htm.

Storie, R. 2007. *It's all about people.* Retrieved March 2007, from http://faculty.winthrop.edu/**storie**c/files/**GEOG101**/lectures/05-**GEOG101**-MapsGIS.pdf that support accessible online learning. Internet and Higher Education 7 (2004) 123–139. Elsevier

Toft, Y. & Joubert, D. (2005). 'Transdisciplinarity' a new opportunity for team problem solving between, across and beyond the disciplines? – A case study. In A. Thatcher, J. James, & A. Todd (Eds.), Proceedings of CybErg 2005. The Fourth International Cyberspace Conference on Ergonomics. Johannesburg: International Ergonomics Association Press. (pp. 609-616).

Transgenerational Design Matters n.d., *Age and Ability*. Retrieved August 15, 2006, from http://www.transgenerational.org

Tye,A. 1991, *Design and Elderly People.* Retrieved September 9, 2006, from http://www.alantyedesignstudio.co.uk

Universal Design Guidelines for Fitness Equipment 2005. Retrieved August 19, 2006, from http://www.beneficialdesigns.com/udgfe

Wattenburg, T. (2004). Beyond legal compliance: Communities of advocacy

WHO/CDC Collaborating Center on Physical Activity and Health Promotion, Atlanta, 2000.

ANNEXURES

Annexure 1

Ken

Key focus areas

Environment:	Functional Safety Outdoors Accessible Encouraging
Product:	Effectiveness Learnability Satisfaction Efficiency Convenience
Personal:	Exercise Motivation Rehabilitation Privacy Supervision

Card Comments

Environment:	Encouraging	*Good leadership is the fuel that inspires.*
	Colour	*Very important for some ppl especially women.*
	Sound	*Quiet preferred, but only possible on own.*
	Lighting	*Maybe roof lights*
	Functional	*Must be. Expert must trust in benefit of exercise machines*
	Mirrors	*Good on two walls*
	Safety	*Consideration increases with age*
	Efficiency	*Work smart is now so obvious*
	Indoors	*Use in and out*
	Outdoors	*Fresh air, space*
	Intuitive	*Dread the sight of floor mats – most painful exercise*
	Comfort	*Yes, temp[erature]. Fresh air*
	Accessible	*CPUT has a charm through being less known*
	Responsive	*Progress feedback*
	Furnishings	*There is too much furniture, too much stuff, drain on material resources.*

		Specific exercise equip good but overall exercise probably …
	Gym	Dread of start up pain. Very important from 40 on. Japan has this enforced at workplace.
	At Home	*All a matter of will power*
Product:	Legibility	*Diagrams*
	Effectiveness	*No unrealistic expectations*
	Responsiveness	*Check against over exertion*
	Programmable	*Only route to go*
	Range of resistance	*Must have on upper limit*
	Perceptible Info	*On screen*
	Adaptability	*Good if possible, for disabilities*
	Flexibility in use	*Exercise station "jungle gym"*
	Learnability	*Same universal*
	Range of movement	*full*
	Efficiency	*profit wise*
	Access/ Egress	*Quick & easy to put on and get off*
	Simplicity and Intuitiveness	*Standardising*
	Adjustability	*Auto-like car seats*
	Performance	*Database based*
	Control	*Need to feel in control*
	App physical effort	*Overload safety switch*
	Equitable use	*Universal*
	Safety	*Relevant to Osh Act*
	Feedback	*Via database, swipe card system*
	Convenience	*Quick to put on and start*
	Tolerance for error	*Minimal*
Personal:	Security	*Car parking*
	Group	*1 group ok*
	Opportunity	*Physiotherapy lead to general gym exercise*
	Support	*Very important*
	Lifestyle	*1.Diet* *2.Daily exercise* *3. Fresh air*
	Comfort	*Showers*
	Exercise	*As a way of life*
	Motivation	*1 on 1 interaction most motivating*
	Safety	*Essential*
	Rehabilitation	*Weakness of Right knee*
	Inclusion	*No preferences*
	Control	*Through instructor*

	Independence	*No preferences*
	Privacy	*Attention, prefer 1 on 1*
	Dignity	*Not important for me*
	Supervision	*For the week willed, trained supervisor, trust*

Andrew

Key Focus Areas

Environment:	Encouraging
	Mirrors
	Sound
	Accessible
	Colour
Product:	Effectiveness
	Aesthetics – *Audio*
	Convenience
	Satisfaction
	Efficiency
Personal:	Rehabilitation
	Progress Tracking
	Lifestyle
	Motivation
	Privacy

Card Comments

Environment:	Safety	*To be observed with safety in mind*
	Efficiency	*As long as everything is together (weight section, cardio, etc)*
	Comfort	*Reception area/ good food court with conveniences like access to the internet*
	Furnishings	*No old style furniture/ everything must be fresh and new/ cutting edge in style*
	Encouraging	*Friendly staff around you. A productive tension free environment*
	Mirrors	*Lots of mirrors its practical & allows you to keep check on your posture & it motivates you*

	Sound	*Acoustics is important. Don't want to hear the sounds of machines.*
	At Home	*Prefer to go away from home to exercise, machines collect 'dust' at home*
	Intuitive	*To follow a natural progression, start at one end and finish at the other.*
	Functional	*Practicality is nb, the gym has to have decent equip & not just look pretty*
	Gym	*In a complex, allows you to do other things after gym*
	Lighting	*Bright, no dark spaces. Lots of windows to see outside*
	Accessible	*Wheelchair friendly to all parts. Bathroom facilities always overlooked!*
	Colour	*Bright uplifting colours, not boring whites*
Product:	Adaptability	*Have to have machines that can adapt to your needs or there is really no point.*
	Responsiveness	*As you progress in your exercise regime this becomes really important.*
	Safety	*Very important*
	Perceptible Info	*Grips on machines could be improved, 'bulky' machines tried to make look better.*
	Adjustability	*Not that important to me as long as it is easy to adjust with assistance.*
	Control	*Must be in control of equipment. Balance on machines important and able to stop the machine during any stage of exercise.*
	Tolerance for Error	*No room for this.*
	Access/ Egress	*Important, need to able to access the machines on your own.*

	Range of Movement	*Important*
	Legibility	*As long as the therapist can read it*
	Flexibility in use	*Very important if machines used for rehab purposes.*
	Appropriate Physical Effort	*Important*
	Performance	*Not as important as the results of the machine.*
	Effectiveness	*Important, goes without saying if the machine is not effective there is no point.*
	Aesthetics – Audio	*Personalized*
	Range of Resistance	*Therapist would be in control*
	Efficiency	*Reduce the size of machines*
	Satisfaction	*Feel as though time is not being wasted, 'not just for show'.*
Personal: *be*	Safety	*Always important, can never overlooked.*
	Inclusion	*Would like more inclusion into group exercise classes.*
	Group	*On occasion for motivation.*
	Independence	*Important to me*
	Comfort	*Bathroom facilities need to be spacious & comfortable, more so than the machines.*
	Rehabilitation	*Important, I want machines & therapist to maximise this.*
	Progress Tracking	*Want to see my progress.*
	Control	*I want to be in control, with the option of asking for help when I need to.*
	Lifestyle	*I would like to try fit it into my life that I don't even notice I'm doing it.*
	Privacy	*Bathroom facilities. I would like them to offer more privacy.*
	Exercise	*Strength training.*
	Motivation	*Really important to me. Music, space & trainer are all important in creating this.*
	Supervision	*I want people around having some, going through the exercise with you I find I work harder.*