A Publication of Design for All Institute of India / July 2012 Vol. 7 No. 7

Design for All

Cover Design: Pego - A one handed kitchen chopping board system designed by Rowan Williams from Loughborough University. His work is discussed in George Torrens' paper "Assistive Technology Product to Universal Design: A Way Forward" email: me@itsrowan.com

Contents for July 2012 Vol. 7 No. 7

Chairman's Desk

Dr Sunil Bhatia

Chief Editor

Design For All Institute of India

www.designforall.in

dr_subha@yahoo.com

91-11-27853470

Emergency is a universal phenomenon and it may occur anytime, anywhere under any circumstances and generally it strikes without notice. What may superficially appear as normal it carries the emergency in womb of normalcy and it may deliver abruptly or in due course of time. 'A slight carelessness in handling may invite disasters.' We generally have objective of construction and any nature of destruction may harm our interest that disturb us. If our objective is destruction and any such activities that stop or delay our objective also disturb. Life is mixture of construction and destruction and no one can escape from it. How beautifully we use these in achieving our objective is a real art. Knowledge is only criteria for anyone to master this art. It is our knowledge that helps in avoiding the danger but our ignorance

takes us closer to it or unknowingly we continue to live along with danger without knowing its consequences. Emergency can be broadly classified as striking of danger with warning signals or without it. No man in this world has absolute knowledge and we live with limited knowledge so our knowing of reason of emergency is partial and our struggle to have complete knowledge makes us progressive. Mostly designers struggle a lot to know and to bring under their controls various potential reasons that can lead to danger. Their helplessness is visible in their design. 'No design is absolute.' Those reasons are yet to be known when it strikes without warning leaves us completely shattered and shocked because it was beyond our perception and did not happen as what we were expecting. Matters fast deteriorate if we do not pay attention or act to control its impact. Those emergencies are beyond our thinking where man is unable to locate the real causes of incidence .That make us to live with the mercy or accept with surrender attitude as it is our destiny. That depressing thoughts never allow us even attempt to think of controlling the reason of emergency. 'Approaching sudden death of products/services is called an emergency.' Designer job is to either prevent those parameters those may lead to sudden death or prove to be reason of damage to products or surrounding environments and designer job is to minimize its damaging effects so it can be useful for optimize of its designed life or it should die naturally after completing its designed life without harming anyone. Satellite is designed for specific life and once it is over it is treated as space garbage and sometime it goes out of its orbit and may damage others. To avoid such incidence scientists work on to destroy it without harming anyone. This emergency situation is handled by their knowledge and I have never heard in my life that fallen destroyed part of satellite was the reason of death of anyone.

Intelligent are those who explore the reason of emergency and at the time of design of products/services they forewarn the user about responsible parameters of casualties or minimize its affects or eliminate its consequences. Design of manual explain the interface of various systems with or within the product and it is generally equipped with necessary warning wherever danger is associated and allows the user to handle the system up to certain level and beyond this is not permitted otherwise it may invite emergency consequences that may to harm to that level which no repairable.

Design of emergency needs special efforts and its warning message should be written in such font size, colour and in familiar language of users that it should be clearly visible and readable from distance. It is advisable that they should more focus in conveying the message by graphical manner and rely on text only wherever it is necessary and unavoidable. Minimal texts should be encouraged and appreciate for designing emergency warning. Design of emergency needs special care and handling. Why do I say more in graphical because at the time of emergency time is crucial to save life and property and no one can afford reading. Psychology of an individual in mob or in emergency situations is totally different what person behaves in peace time. A question of life and death makes person with different behaviour and he is not governed by what he has learned rather his natural instincts of survival takes charge for taking him out of the danger. A situation where question of life and death may come face to face in those places designers should consider all possible angles and not allow leaving any remotest possibilities of danger. Recent incident of nuclear disaster in Japan is an example where team of designers could not visualize that earthquake, tsunami and nuclear disaster will strike simultaneously and their ripple effects will be unimaginable in entire human history. It was the fault of the designers that has invited such quantum of

nuclear disasters. It is advisable that such incidents should not repeat, designers should take care with top priority. Wherever it may cause damage to the products it should be handle with cautions and preventions, and wherever a few errors simply takes away temporarily the life of design objective of products /services it should highlighted with inbuilt warning. Prevention or complete control should be incorporated at the time of design for averting any emergency.

Emergency may invite danger and its affects varies with its intensity. While running an automobile a reserve knob of the gasoline reminds the user that gasoline is capable to run few kilometres and it needs gasoline otherwise automobile will stop functioning. Ignoring the warning may lead to emergency. If there is place where accident prone area ,designer introduces the signage of warning or rumbles on that stretch of approaching roads or various types of speed breakers so that user should be mentally alert for complete control of the vehicle and in position to perform best in facing any emergency situations. When all precautions fails for averting the incidents then designer should work on minimizing its adverse impact and design that in such a way it should not be fatal but under the control. Introduction of car air bag in automobile that inflates to save the life of passenger as it senses some shock comes under this category. Similarly overhead water tank at top of the roof is difficult to physically inspect for checking the level of water in tank. No one can go to roof every time when there is water supply because this exercise may invite some untoward incident or death, to avoid any such casualties designers have designed the product with sensor that automatically cut off the supply of water as it reaches the desire level of water in tank. This exercise save the life and controls the wastage of water. Various types of shoes, clothes and other accessories are designed to handle the emergency. At the time of recent nuclear disaster in Japan, the rescue

team was wearing special designed clothes so that they should expose to minimum radiation and life should not be in danger. Shoes may be fashion statement for some but it is necessity for others. Elite class is symbol of economy of state and their life style is the parameter for judging the economy. If celebrities uses the same shoes or dress in many occasions that indicates the economy is in bad shape and they cannot afford to use various style statement accessories. Shoes are essentials for some where demand is to counter the harsh environments. Fire resistant shoes are required because fire has inbuilt character to burn whosoever come into contact. Human body is highly venerable and slight high temperature may prove fatal or life will be in danger because of heat. Industrial workers of forging or steel industries job demands is to work in front of high temperature furnace and they cannot escape from its effects. A forest officer demand is gum boots to meet the challenges of difficult terrains. Designer job is to design the products/services to meet the different challenges and some time simply using the idea serve to solve the purpose of many adverse conditions. What is the difference between the civilian and army personnel? One is not trained to meet the challenges of sudden emergency and other is trained by creating such artificial situations and allows them to react in desired manner. It is the training of emergency that creates the distinction.

Sometime emergency situation is inbuilt with the product it may equip with avoidable or unavoidable parameters or it is affected by other outside parameters but it is beyond the control of designers. For example, automobile wheels are made of rubber and puncture may happen anytime because everywhere ideal roads are not possible and small sharp items may prove reason for puncture. Designers at this moment think with narrow focus ‘how to design the functional products under these conditions and never bother to correct ‘how to design the

road to make the ideal for automobile.' For immediate solution they either design the wheel with tubeless tyre or introduce some chemicals between tube and tyre to seal any puncture that can deflate the tube or provide extra wheel that can be easily replaced the defective wheel. Similarly emergency transport system for patient needs special design. Designer cannot avoid the situations of crowded or narrow areas to approach the hospital or vehicle may pass through narrow lanes for lifting the patient or any reason that is out of his/her hands and vehicle is not allowed to move faster and patient may die on the way. To control such situations they designed the vehicle with all equipment to meet any challenges related to patients and provide all the medical facilities till he/she reaches to hospital. Better design ambulance, better chances of survival of patient. I call this a moral emergency design where designers are focusing to save the life of patient. There is another example of moral emergency when woman enjoys the sex, conceive and wishes to terminate the pregnancy before life begins. She takes the emergency oral pills for termination of the process of conceives. She is mentally not prepared to carry the child but lives under the obligation of religion and moral she wishes to terminate before life begins in womb otherwise after a delay termination may give the impression of murdering the child by giving pills. It will disturb her psychology.

Fire or water if it is under control of human it is useful for living beings. Out of control can create havoc. Biggest challenge to the designer is 'How to control the fire or water for the benefits of mankind'. Designers are using all possible best technologies but results are not worth mentioning and man proves helpless in the hand of nature at the time of volcano, forest fire and floods etc. Fire or water has capabilities to create emergency when man losses his control over it and it destroys the lives or property in no time. Our designers should

pay proper attention to meet such challenges. This loss can be prevented by introducing pre loss management or minimizing by post loss and simultaneously works to achieve normalcy as quickly they can. Both need different treatment of design management. Just like what our government is following the policy of controlling the population of challenged by giving them proper facilities? Introducing proper medication at the time of conceiving, delivery and post-delivery can prevent various forms of disabilities. Once someone is born with one kind of challenge needs lifelong management till he/she dies naturally. Governments are using preventive policies to control such emergencies and in case it has happened they have different policies. It is combination of social as well as moral duty to design to meet the challenges after the disaster.

In James Bond films emergency is designed in such a way that it has become standardized for entire film communities and idea of entertainment is such a popular that our designers are not untouched with these popular concepts and uses extensively in their designed products because it does not need cost of educating the users. As hero enters to destroy the den of villain, an emergency system alert by using peculiar harsh sound and special colour light bulbs start blinking. This multimedia design shows to the audience that emergency has arrived and some trouble is ahead 'Be alert'. I have never heard or seen that emergency alarm is with very soothing sound and colour of indicator is attractive. Normally warning colour is red and sound pitch is piercing to ear. The purpose of the design is to make the associated person alert and to meet any eventualities. Another specialty of James Bond film is that his organization has innovative department that design products/ services to meet the emergency challenges may face by James Bond. Designers expect these situations may come and to meet that emergency our hero should be well equipped. Similarly our

body releases signals for attraction of opposite sex and at the time of emergency his/her body languages changes and other person senses some harm and devised to escape from any harm may cause by other partner. Some time they designed and come out safely and if fails they become victim of other person. This instinct to counter emergency situation is visible in man from the day he was born. 'If arrow would have not design by man it would have been part of the branch of the tree.' Our body acts in different manner at the time of peace and altogether different in emergency. In emergency our body releases certain specific hormones that makes the person abnormal and perform such action that he cannot perform in normal circumstances. My advice to the designers that while designing the alarm they should use the universal traits of human body like level of estrogens, adrenal glands and reflex system. If we ignore these parameters designed products will be incomplete to tackle the emergency in suitable manner. A small error and things may go hay way and will never come back to original shape and damage is irrevocable. Emergency situations generate panic and those time people never behave as what he does in normal time. To control such psychological disturbances in human and it may lead to further damage we should very carefully designed to meet all possible known eventualities associated with the products. Ecology is the stage on which selection of the fittest occurs, and the discipline of behavioral ecology deals with the optimal design of behavior.

I am narrating my own experience that it is common practice before entering the lecture hall we relieve ourselves so that attention should not be disturbed during my lecture. After urinating as I pulled the zip of my pant it did not work and my flies was open. It was very difficult to face the embarrassing situation. An idea struck in my mind and asked the office staff for stapler and I quickly stapled my flies and

went to lecture hall. It was an emergency and I tried my best in solving that problem with whatever material was available that time and judged this is the best solution I can do in this emergency situation for avoiding embarrassing conditions. In another incidence a man was hurt and his cut was so deep that his flowing blood might be prove reason of his death. There was no medical facility in near vicinity and I was nervous, worried but feeling helpless for saving life of bleeding man and emergency was pressurizing me to act fast for saving his life. An illiterate man appeared from nowhere and I guessed he is carpenter and asked me 'is there any hospital nearby or call the ambulance or police.' I explained by the time we will call, this man will die. There is emergency to control his bleeding otherwise he will die on the way to hospital. He opened his dirty bag and took out a small tube of industrial glue. He filled the few drops of industrial glue in his cut and immediately tied with long cloth. In few seconds bleeding was under control and we transported him to hospital. Doctor appreciated that carpenter presence of mind the way he used the glue to save the life .It is my advice to designer that they should know how to use the available material for finding out the solution. My emergency has come because my pant was lacking back up. If I would have back up I would have not act in haste. When designer know this may fail they should always think to meet the emergency by introducing the back up. At the time of road accident person who was appeared illiterate proved much educated by his sense of using various products for saving life in emergency. At operation theatre failure of electricity can cause the death of patient to avoid such situations we should design the operation theatre with either generator or inverter. Light failure in elevator may cause panic among passengers to avoid such situations they should provide backup design or to control the anxiety they should be able to communicate with authority and should design the independent taking system.

Designing of handling the emergency is tricky. Some emergency are indicated by alarm, warnings and the certain situation can harm the product. Job of designers is to analyze various variables associated with products/ services and identifies define the lower and upper limit of those variables to define parameters. We know electrical appliances are designed to use the supply of electricity of specific voltage and ampere provided by power generations companies and they follow universal standards. Certain situations may occur where voltage surges to that level it may damage the appliances or risk the life of the user. To control they have designed voltage stabilizers. It protects from certain known casualties. Similarly to control the sudden rise in ampere designer uses fuses or earth leakage trip governed by magnetic circuit breakers. My philosophy of meeting the challenges of emergency is to identify all possible inbuilt dangers situations if specific parameters may go out of the limit and analyzing its possible degrees of effects on products. The effects of product will ultimately affect the users. Other is from the social point of view that is associated with moral of an individual. It is similar to imagine the person is living without government and what will be his possible actions that can damage the society. What is the tolerable level of person and however, the temporary dysfunction of government in responding to some disasters, and different abilities of citizens to prepare for or effectively respond to disasters without functional government. Moral theory with the insight that the only thing in the world is good without qualification is a good will, or benevolence. User's duty ethics at the time of using the products / services plays significant role at the time of designing to meet the challenges of the emergency. To meet such situations we should design in two level first is: design so that the generalization or maxim of actions can be willed as general rule of universal design and second formulation is: Never treat another human being as a means, but always treat others

and oneself, as ends. Every designers should know the mitigation (it saves lives, reduces property damage, and helps to preserve the economy in the disaster area), preparedness (Planning how to respond should an emergency), response (The period of time shortly before, during and after a disaster, during which activities are conducted to save lives and minimize damage) and finally recovery (The period of time when the immediate threat to life and property has passed, and cleanup, repair, and restoration activities become a priority).

Above all we should understand that in emergency man behaves in altogether manner what he will not do in normal time. This tendency is visible in animal also. It means when our organs feels that a danger is close and life is it risk, his all senses are shut down and minds become blank. That time our nervous system takes the charge to take out from danger and it has its own way of working and it not governed by our learned knowledge This is the problem of designer that they use the learned knowledge for designing the emergency and it prove no use to ultimate sufferers. We as designer, at the time of designing the emergency products keep in mind the psychology of man as an individual as well in mob. It is my appeal to our expert designers and young designers that they should design the sign of EXIT and it should have universal appeal. I have never come across anywhere in the world the sign of exit. They warn by mentioning that 'in case of emergency use staircase or door etc.' and that too written in local language.

We are thankful to Senior Lecturer Dr. Eujin Pei of De Montfort University for accepting our invitation as Guest Editor for our special issue. He did his job with utmost sincerity, honesty and this is reflected in his work. He has done complete justice with his role and what you see is result of a Guest Editor. I salute his enthusiasm.

With Regards,

Dr. Sunil Bhatia
Design for All Institute of India
www.designforall.in
dr_subha@yahoo.com
91-11-27853470®

Guest Editor

Dr Eujin Pei

De Montfort University, School of Design

Faculty of Art, Design and Humanities

Leicester LE1 9BH

United Kingdom

email: epei@dmu.ac.uk

Eujin is the Guest Editor for this issue's Design for All. He works as a Senior Lecturer in Product and Furniture Design at De Montfort University in the United Kingdom with research interests in Inclusive Design, Additive Manufacture and New Product Development. He has worked at leading institutions including Brunel University, Loughborough University, University of Southampton and Vaal University of Technology. Eujin is a Member of the Editorial Advisory Board for the Journal of Assembly Automation, Fellow of the Royal Society for the Arts, Manufactures and Commerce (RSA), and Member of the Design Research Society (DRS).

Foreword

The 2012 Global Financial Stability Report[1] by the International Monetary Fund (IMF) warns of the potential huge costs associated with an ageing society. They pointed out that most planners underestimate the longevity of the population by three years on average; and this miscalculation could potentially double the cost of ageing by 2050, amounting to tens of trillions of dollars in pension costs. They also predicted that developed countries would have to set aside another 50 per cent of their 2010 Gross Domestic Product (GDP) budget, and developing nations, to set aside an addition of 25 per cent. In the report, the IMF said that the inaccurate estimation of life expectancy arose because forecasting was based on historical information where life expectancy would slow down. However, this contradicts today's scenario where there more advance medical treatment is now available, as well as improved quality of life. The IMF estimated that this error in calculation would cause Japan that has the fastest ageing population in the world an extra 87 per cent of their 2010 GDP by 2050 if Japanese live three years longer than expected.

In this issue of Design for All, a wide range of issues relating to Inclusive Design is addressed. Dr Sunil Bhatia, Chief Editor of Design for All, highlighted the importance of designing for emergency situations, such as products or services that forewarn users or to minimise the effects of such situations when they arise. He narrated his own personal experience in dealing with emergencies in an ad hoc manner, using available materials to be best way possible to deal with such situations.

Assist. Prof. Yasemin Afacan shares with us that the most challenging decisions of architects and designers are solutions that are required for personal spaces, and in particular wet bathrooms. She compiles a set

of recommendations to achieve good ergonomics encompassing aspects of circulation, storage units, WCs, basins, shower/bathtub, illumination and materials, all of which is summarised in the diagram of seven components for a user-friendly bathroom design. Finally, Yasemin suggested that design excellence can be achieved when an integrated approach is adopted rather than having additional design solutions.

Dr Kate Carroll and her colleagues from the College of Textiles at the North Carolina State University propose the provision of an inclusively designed brassiere for developing regions of the world, giving the wearer physical, emotional, cultural and economic stature. They discuss how low wages and lack of availability have made it almost impossible for women in developing regions to afford a bra and subsequently develop the Peace Bra as an affordable undergarment.

Siak Koon Goh and Cheryl Wee shares with us how the Live Well Collaborative – Singapore (LWC-S) has worked as an independent innovation research centre that tests and develops products specifically for consumers aged 50 and above in Asia. They have worked with Multinational companies and multi-disciplinary teams of students to bring original primary research material and to develop thoughtful, innovative product solutions, as evident in the case-studies involving aerospace giant Boeing and with Proctor & Gamble.

Based at the Digital World Research Centre, University of Surrey, Dr Christopher Lim shares with us that his research identified the concerns of participants from the ‘electro-mechanical’ generation (those born before 1930) regarding information communication technology (ICT). He claimed that as we grow older, the ability to reject learned concepts from the past and replacing them with new

ones becomes more difficult; and although older people are able to learn new tasks, difficulties in forming an automated response means that learning new tasks can be difficult as these require greater cognitive load. More interesting, he epitomised that each generation develops a familiarity with the technologies of their own era, and at a particular stage of their lives, this familiarity can become both a preferred and enduring basis for choosing technology and way of interacting with products throughout their lives. Christopher suggests that designers and engineers need to be aware of such generation-related effects when designing new ICT products mainly due to cognitive changes as one ages and the lack of knowledge, experience and skills in handling interfaces that appear after one's formative years. This is particular relevant when we move beyond a graphical user interface to tangible user interface where advanced input and output devices such as electromagnetic, optical, acoustics and kinaesthetic, 3D or augmented technologies are now more widely used.

Professor Jeremy Myerson from the Helen Hamlyn Centre for Design, Royal College of Art shares with us about the i~design research project that has successfully raised the profile and uptake of inclusive design in business and practice. He describes the various specific tools for designers that were produced during the project, and explains how these were tested as part of a design brief for a London design firm to design a new way to de-ice a car windscreen in winter. To see tools such as the Inclusive Design Toolkit, the Context Calculator and the Designing With People website being used in real-time in a design exercise gave the research team further insights into how these design aids could be refined and better communicated to the design industry.

Claudia Rebola and her colleagues contributed to the article on “Designing New Technologies within a Participatory Approach”. Their work centred on the aspect of voting which is described as a basic part of participating in democracy, yet many people especially those with disabilities face a variety of physical and social barriers to cast their ballot. The researchers organised a multidisciplinary focus group comprising of researchers, election officials, vendors, advocates and voters with disabilities to get together in a series of moderated participatory design workshops, following which they developed a variety of concepts encompassing a more effective registration process, better access to the polling station, and using voting technologies.

Ruth Sims and her colleagues from Loughborough University shared with us how activities of daily life still cause problems for many older and physically impaired people. A survey of 50 elderly and disabled participants found that surprising numbers were unable to achieve the level of independence that they wished; and despite having advances in technology and equipment design, these basic activities are still proving too difficult for a sizeable percentage of the older/disabled population. They suggested that good design should be able to improve the situation for many older and disabled people.

Lastly, George Torrens proposed the Loughborough Assistive Technology-User Centred Design (LAT-UCD) methodology, suggesting that the framework offers a more structured approach towards producing a commercially viable and desirable AT product. Case studies from current (2011-2012) Finalist undergraduate Industrial Design (ID) student product designs are used to support the principles described that uses a combination of conventional evidenced-based NPD alongside specific methods of the manipulation of perception and

semantic meaning. Design tools such as value web-diagrams, technology footprint, iconography and product DNA are also demonstrated within the NPD examples.

It is an honour to be invited as a Guest Editor for this issue's of Design for All and I trust that you will enjoy reading the articles. Have a great summer and happy reading!

With regards,

Dr Eujin Pei
De Montfort University, School of Design
Faculty of Art, Design and Humanities
Leicester LE1 9BH
United Kingdom
email: epei@dmu.ac.uk

1. International Monetary Fund (IMF) (2012) "World Economic and Financial Surveys: Global Financial Stability Report - The Quest for Lasting Stability, April 2012" accessed online (28 June 2012) http://www.imf.org/External/Pubs/FT/GFSR/2012/01/pdf/text.pdf

Forthcoming Issues

August 2012 Vol-7, No-8

This is special issue will be led by Guest editor Ms. Ana Maria Marquis Garcia Rodrigues who holds a Business Management degree. Since 2008, she is the Managing Partner of *Accessible Portugal*, a Portuguese tourism company founded in 2005 and focused on people with special needs, their families and friends. *Accessible Portugal* has been talking with major players in the field, spreading good policies and practices and suggesting reasonable changes which would benefit all in their places or projects.

September 2012 Vol-7 No-9

The theme of special issue is: "Design of equipments for carrying out physiotherapy at home" with Department of Industrial Design ,School of Planning and Architecture, New Delhi and Guest Editor will be Manoj Mathur, Professor and Head of Department and Ms. Krity Gera Lecturer in Industrial Design

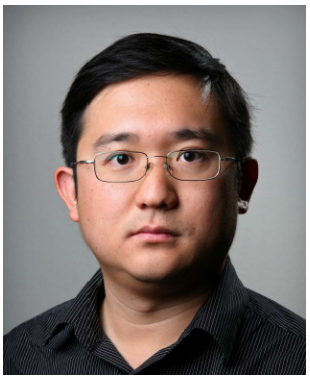
November 2012 Vol-7 No-11

Josyane Franc has been Director of International Affairs Cite du Design & Saint-Etienne School of Art & Design (ESADSE) since 1989. She has accepted our invitation as Guest Editor for special issue on designers from France.

December 2012 Vol-7 No-12

Edward Steinfeld, Arch. D., AIA, Professor of Architecture and Director Centre for Inclusive Design and Environmental Access School of Architecture and Planning University at Buffalo, State University of New York will be the Guest Editor for December 2012 Vol-7 No-12

May 2013 Vol-8 No-5



Dr. Kenneth Joh is an Assistant Professor in the Department of Landscape Architecture and Urban Planning at Texas A&M University, Program Coordinator of the Graduate Certificate Program in Transportation Planning, and an Assistant Research Scientist at the Texas Transportation Institute. He will be the Guest Editor of this special issue

July 2013 Vol-8 No-7

Christian Guellerin is president of Cumulus, the International Association of Universities and Schools of Design, Art and Media since 2007. The organization counts 178 establishments in 44 countries. He is also the executive director of the Ecole de design Nantes Atlantique, which trains professionals to create and innovate for socio-economic development, with an interface between technology, economics, and the sciences. Today they're expanding to China and

India. He writes on design and pedagogy. He will act as philosopher & guide for this special issue and students of different streams will participate in this special issue.

August 2013 Vol-8 No-8

Dr. Antika Sawadsri PhD in Architecture, Planning and Landscape University of Newcastle upon Tyne, UK. Lecturer, School of Interior-Architectural Design (2004-present) Faculty of Architecture King Mongkut's Institute of Technology Ladkrabang (KMITL) Thailand will supervise this special issue on student designers.

Ergonomic Wet Spaces: Design Factors in Bathrooms Designed for All

Yasemin Afacan,

Assistant Professor

Department of Interior Architecture & Environmental Design Faculty of Art, Design and Architecture Bilkent University

TR-06800 Bilkent, Ankara, Turkey

e-mail: yasemine@bilkent.edu.tr

Yasemin Afacan is an assistant professor in the Department of Interior Architecture and Environmental Design in Bilkent University, Ankara, Turkey. She holds a PhD in interior architecture from Bilkent University in 2008 and master of architecture from Middle East Technical University in 2004. Before joining Bilkent University, she worked as a lecturer in Queens University Belfast, UK. She has published in Applied Ergonomics, Journal of Engineering Design and Knowledge-based Systems and in various in refereed journals internationally. She teaches design processes and sustainable design for interiors, and her research interest is focused on inclusive design (processes, tools, and methodology), aging studies, and architectural design education.

Ergonomic Wet Spaces: Design Factors in Bathrooms Designed for All

Yasemin Afacan

Department of Interior Architecture & Environmental Design Faculty of Art, Design and Architecture Bilkent University

TR-06800 Bilkent, Ankara, Turkey

Abstract

Design decisions are directly related to efficient functioning of residential environments and equally responding these environments to diverse user demands. The most challenging decisions of architects and designers are the solutions that are required for non–discriminating wet spaces. In that sense, rather than having special solutions, there is a need of usable, accessible and understandable kitchens and bathrooms in Turkish society, where there is an increase in aging and disabled society. This study analysed the bathroom literature under three approaches: universal design, design for all and inclusive design. According to the analysis results, the design factors for ergonomic bathrooms encompass: circulation, storage units, WCs, basins, shower/bathtub, illumination, materials. Furthermore, the relationships among those are discussed according to diverse user groups. As a result, user needs are changing parametrically based on the diversity of disabilities, which makes an integrated approach essential rather than additional design solutions.

1. Introduction

Residential bathrooms and toilets are the wet spaces that everyone regardless his/her physical condition or limitation wants to use independently with comfort. Different than kitchens, the privacy issue in bathrooms brings also some limitations in terms of function and aesthetics. In this respect, the most difficult decisions done by architects and interior architects are the decisions related to design of bathroom and sanitary elements that need to be done without any segregation. “The fundamental basis of the bathroom, as a place of relaxation and generation, has its roots in the social and cultural history of the bathtub” (Mullick, 2001, p. 42.3). The first bathroom technology at homes has appeared in 1900, where life expectancy was 44, which means that bathroom users were young and were not associated with any physical limitation. However, because of the changes in technology and new developments in health and design, life expectancy becomes longer and user profile changed. In the 21st century in the majority of the world, in Turkey as well, there has been an increase in the aging population and people with disabilities. Thus, designing inclusive spaces can be seen as a response to accommodate diverse people within the built environment as efficiently, effectively, and satisfactorily as possible, regardless of health, body size, strength, experience, mobility and/or age. Although technological innovation has brought many benefits into architecture and planning, there is still difficulty to embed inclusive design data in bathroom design. The feedback loops among designer, environment and user triangle should be continuous and interacted (Figure 1). For example, a bathroom designed by architect according to regulations and standards is questioned and shaped first by user, then it comes back to architect to be finalized according to the user requirements, demands and expectations.

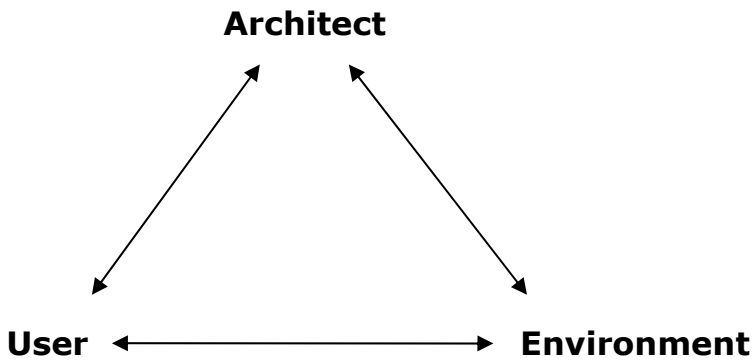


Figure 1: Feedback loops among designer, environment and user triangle

For the efficiency and effectiveness of this triangle, in the last decade in US, Europe and Japan most of the research and applications have been done in inclusive design area in every aspect from product design to space allocations, standards and regulations are developed for user-friendly interior spaces and architects, designers and interior architects are encouraged and required to design bathrooms and toilets according to these principles and criteria (Ostroff, 2001). Although bathrooms in the literature are explained under three components- the tub, washbasin and toilet for disposing, this study analyzes the bathroom space under seven components: 1) circulation; 2) storage units; 3) toilets; 4) washbasin; 5) bathtub/shower; 6) illumination; 7) material. Despite the extensive literature on these seven categories and worldwide expertise around user requirements, it is not easy to navigate the mass of data and interpret it into the cultural context. Therefore, different than other studies, this study aims to gather, analyze, and then synthesize all the data on bathroom literature in order to promote public opinion toward a positive inclusive bathroom design attitude, encourage designers to design toilets inclusively, make society sensitive to inclusive toilet design and get informed about diverse user needs, capabilities and expectations.

2. Methodology

The study reviewed and analyzed the bathroom literature according to universal design, design for all and inclusive design concepts. Although all these terms are commonly used to describe the philosophy that promotes human diversity and functioning, there has been a developmental change in the language and social policies (Ostroff, 2001). Clarkson et al; (2003) and Cassim et al. (2007) explained the differences among those concepts as follows: “some of these, such as ‘design for all’ and ‘universal design’, reflected the aspirations of campaigning disability groups in Europe and the US. Others, such as ‘inclusive design’ and ‘transgenerational design’ reflected the social, economic and demographic factors that were impacting on markets and governments and driving the reassessment of design goals and approaches among the design management, education and research communities”. The bathroom design by its nature requires both a disability approach and a process of decision assessment. In this respect, the methodology of the study is based on annotated bibliography of universal design, design for all and inclusive design concepts. The bathroom requirements and its seven components listed above are critically analyzed. Table 1 illustrates the analyzed literature references in detail. It is essential to state that this study included the most cited references and works on bathroom literature all over the world, and in Turkey as well. In the table, one reference is listed sometimes under more than one concept, because these three concepts can highlight common themes with an approach to the design of mainstream products and services that are accessible and usable by as many people as possible (Cassim et al., 2007). In the next section, the seven components are elaborated based on these three concepts, their importance for an ergonomic bathroom design is discussed critically and their interactions with diverse user groups are mentioned.

Universal design	Design for all	Inclusive design
Practicing Universal Design Wilkoff and Abed (1994)	European Usability Handbook (1995)	Home design according to life pattern (Atala, 1990)
Designing for the Disabled the New Paradigm. Goldsmith (1997)	Designing for the Disabled the New Paradigm. Goldsmith (1997)	Designing for the Disabled the New Paradigm. Goldsmith (1997)
The International Best Practices in Universal Design: A Comparative Study (Canadian Government, 2000)	The International Best Practices in Universal Design: A Comparative Study (Canadian Government, 2000)	The International Best Practices in Universal Design: A Comparative Study (Canadian Government, 2000)
Affordable and Universal Homes (NCSU, 2000)	Design for all (Aaoutils, 2003)	Bathroom and Kitchen Design Principles for Elderly Users (Savut, 2007)
Universal Bathrooms (Mullick, 2001)	A Study on Usability Problems of Elderly Users in Bathrooms (Tezel, 2005)	Design for Inclusivity (Coleman et al., 2007)

Gold, Silver and Bronze Universal Design Features in Houses (NCSU, 2001)	Mimari Projelerde Engelli ve Yaşlılarla İlgili Olarak Uyulması Gereken Kurallar (İzmir Mimarlar Odası, 2005).	Inclusive Design Toolkit (Clarkson et al., 2007)
Residential Rehabilitation, Remodelling and Universal Design (NCSU, 2006)	Build for All (European Commission, 2006)	Designing Inclusive Features (Langdon et al. 2008)
Bathroom and Kitchen Design Principles for Elderly Users (Savut, 2007)	Bathroom and Kitchen Design Principles for Elderly Users (Savut, 2007)	Designing for an Aging Population: Residential Preferences of The Turkish Elderly to Age in Place (Afacan, 2008)
The Importance of Universal Design in Home Architecture: A Case Study with Elderly Users (Afacan, 2011)	Designing for an Aging Population: Residential Preferences of The Turkish Elderly to Age in Place (Afacan, 2008)	Designing Inclusive Interactions (Langdon et al. 2009)

Table 1: Literature references.

3. Findings

The usability and accessibility of a bathroom are directly related with its response to elderly people's requirements, disabled people's expectations and its design correspondence to user demands regardless of ability, age and size (European Usability Handbook (1995). The design of bathrooms includes an integrative design thinking of many physical and social aspects at the same time. The inclusivity degree of these aspects is closely related how they are handled throughout design process to eliminate any limitations (Clarkson et al., 2007). Although in 1900's ergonomics and usability terms in bathrooms were not so much emphasized (Mullick, 2001), today's bathroom architecture becomes user-centred and varied in terms of sustainable developments, such as effective water and energy usages. The following seven sub-sections elaborate how a bathroom design should be according to universal design, design for all and inclusive design concepts.

3.1 Circulation

Considering the Turkish living patterns, the apartments usually provide small, squeezed and inappropriate spaces for bathroom allocations. However, the common point of all the three concepts highlights the necessity of clearance for manoeuvring (clear area with 150 cm diameter), stepless entrance, and comfortable access for all regardless ability, age and size Afacan, 2011; Aaoutils, 2003; Canadian Government, 2000; Savut, 2007). In front of washbasin, there is a need of a clear rectangle at least 120 cm x150 cm, whereas 76 cm x120 cm in front of shower and 76 cm x150 cm in front of bathtub. The doors should open outside for a safe and comfortable usage. The location of bathrooms should be designed near bedrooms considering the disability problems and age requirements (Mullick, 2001). It should

provide adaptable, flexible and comfortable solution for sanitary design.

3.2 Storage Units

The storage units in bathrooms can be under counter and/or above counter. Clarkson et al. (2007) suggested using lighting elements inside cabinets for elderly and people with visual disabilities. According to Mullick (2001) cabinet and shelf heights are critical, which should be accessible and reachable with comfort. Regardless of bathroom plan and size, storage unit under washbasin and/or its doors should be easily removed for a wheelchair person usage (NCSU, 2001). The handles should be easily operable for people having muscle problems. Corners should be rounded for safety reasons (NCSU, 2000; 2001; 2006). The height of mirror should be considered along storage units, angled for wheelchair users' usage and located at100-200 cm height above the finished floor. Finally, according to Savut (2007) built-in closets can contribute positively to the effective usage of an interior space by providing more manoeuvring area in bathrooms.

3.3 Toilets

There is a strong relationship between the toilet usage and size and location of washbasin and bathtub/shower. As mentioned above, universal design, design for all and inclusive design concepts commonly emphasize usability of toilets with comfort and safety. The toilet usage can be varied depending on the physical ability, wheelchair/crutch/cane usage and left and/or right handed situation (Clarkson et al., 2007). In this respect, toilets should be designed to be used and approached from both sides. International Best Practices in Universal Design (Canadian Government, 2000) defined an ideal toilet height at 46-48 cm above the finished floor, whereas US regulations stated at 43-48 cm and Spain regulations at 45-50 cm

above the finished floor. The flushing tank should be automatic and/or with sensors, which should be located at 60-110 cm height above the finished floor (Canadian Government, 2000). For elderly and physically disabled people's usage, grab bars should be provided, which can carry up to 120 kg load capacity. The sanitary paper location should be located at 48 cm height above the finished floor (Canadian Government, 2000).

3.4 Wash basins

In addition to hand washing, it is important that a washbasin with its surrounding area provides an accessible, usable space and comfortable for make-up, shaving, hair brushing purposes (NCSU; 2000; 2001; 2006). According to Savut (2007), if there are two washbasins in the same counter, then the critical issue is to use them safely, comfortably and easily both of them at the same time. The distance between them from centre to centre should be 75-90 cm. The ideal washbasin height should be 80-85 cm above the finished floor (Canadian Government, 2000). According to the needs of a wheelchair user, the services under washbasin should be thought about carefully. The fixtures should be easily reachable, usable from all positions and equipped with thermostats. If there would be sensors, then the fixture should stay open at least ten seconds.

3.5 Bathtubs/showers

As mentioned above in other bathroom elements, the ease of use in bathtubs/showers helps body cleaning activities to be done in a safe and comfortable manner. Compared to bathtubs, shower usage is easier and safer (Savut, 2007). The reason for this is that in Turkish culture, the bathtubs are seen as inaccessible spaces, which are treated as storage spaces. However, if there is a bathtub usage, then architects should provide grab bars, ease of access and a comfortable

seating unit within the bathtub (Afacan, 2008; Canadian Government, 2000; Mullick, 2001). The grab bars should be designed at side and back walls, which are reinforced concrete. Their length should be 35 cm at the back wall and 60 cm at the side wall and positioned ideally at 75-85 cm height above the finished floor. The fixtures, such as shower head etc., should be easily operable and reachable with comfort from any position. An alarm system for emergency situations is not only necessary for elderly people but also for everyone (Clarkson et al., 2007). For a wheelchair person's usage, a bathtub door needs to be designed and any level changes should be avoided. Moreover, the size for an inclusively designed bathtub should be increased to 160 cm x 140 cm (Chamber of Architects of Turkey, Izmir Branch, 2005).

3.6 Illumination

Bathrooms in Turkey within the apartment living pattern are the spaces, which are usually dark and receive minimum natural light (Afacan, 2008). According to 'The International Best Practices in Universal Design' (Canadian Government, 2000), the illumination level should be 200 lx. Although elderly people require more light in interior spaces (Savut, 2007), for visually disabled people illumination levels more than needed, could be sometimes uncomfortable (Afacan, 2008; 2011). It should be noted that illumination levels around washbasin and mirror are critical and should be carefully analyzed. In addition to ten appropriate illuminations, the ventilation becomes also essential. If possible, natural ventilation through openings should be provided preferably, if not then user-friendly mechanical ventilation equipments should be provided in order to achieve maximum thermal comfort for all. The indoor air quality of an interior space affects directly user satisfaction, efficiency and effectiveness (Bingelli, 2010).

3.7 Material

Bathroom materials in the 21st century are not only limited with porcelain and/or ceramic, but there are also usages of corian, stone, wall paper, glass and stainless steel as material choices. Universal design, design for all and inclusive design approaches emphasize commonly the necessity of slip-resistance and non-reflectance character of used materials. Particularly, for people with wheelchairs and crutches, designers should use floor materials without any textures and level changes that can be problematic for manoeuvring and walking. On the other hand, needs of people with visual disabilities should be also considered; colour contrast and wayfinding guidance on floor and wall materials should be provided, especially in front of washbasins and bathtubs (Afacan, 2008).

4. Conclusion

In summary, bathrooms are inevitable parts of living environments, which should be equitable, flexible and adaptable in use for every user. Although responding to the requirements of all the seven components explained above at the same time for an ergonomic bathroom solution could be seen at first as a complex parametric problem and expensive solution alternative, such a designed, carefully analyzed, synthesized and evaluated bathroom solution brings sustainability and ease of maintenance for long years without the need of any addition and adaptation requirement for elderly and/or disabled people, which makes it then cost-effective as well. As a result, we as designers face with the following question: why we are designing unusable bathrooms without comfort and access? A bathroom, which requires special solutions for elderly and disabled people, is much more expensive and unsustainable. It should not be forgotten that the culture defines the usage, but the key issue is that a well-designed and user-friendly bathroom is the result of a holistic design and interdisciplinary

approach integrated with all three concepts of universal design, design for all and inclusive design. Figure 2 summarizes the seven components mentioned above in an illustrative format as well.

5. Notes

The earlier version of the study was presented in the national conference on '17th Ergonomics' on 14-16th October 2011, in Eskisehir, Turkey and has been adapted for the Design for All publication.

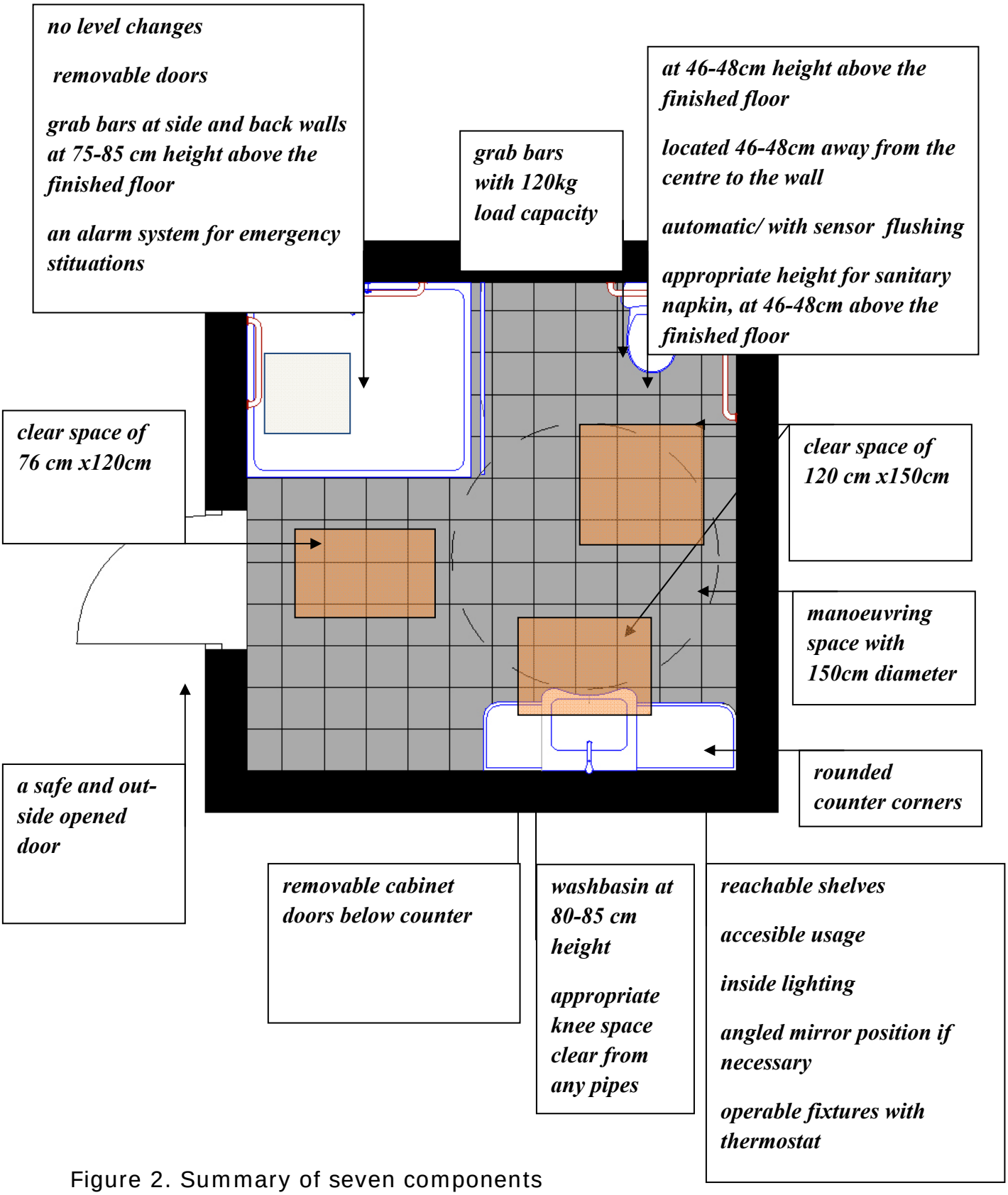


Figure 2. Summary of seven components for a user-friendly bathroom design.

6. References

Aaoutils Project (2003). *Design for All Booklet* http://www.anlh.be/aaoutils/index.html Accessed online: 9 September 2011.

Afacan Y. (2008). Designing for an Aging Population: Residential Preferences of the Turkish Elderly to Age in Place, In *Designing Inclusive Futures,* Langdon P, Clarkson P J, Robinson P (Eds.), London: Springer, pp. 241-252.

Afacan Y. (2011). The Importance of Universal Design in Home Architecture: A Case Study with Elderly Users, *Yapı Journal*, 357 August, 96-99.

Atala E. (1990). *Home Design according to Life Pattern*, Turkish Armed Forces Rehabilitation and Care Center, Ankara: Tepe Group Publishing.

Binggeli, Corky. (2010). Building Systems for Interior Designers, 2nd edition. New Jersey: Wiley.

Canadian Government (2000). The International Best Practices in Universal Design: A Comparative Study, Betty Dion Enterprises Ltd, Canada, CD-ROM.

Cassim J., Coleman R., Clarkson J., Dong H. (2007). Why Inclusive Design? In *Design for Inclusivity*, Coleman R., Clarkson J., Dong H., Cassim J., (Eds.) Hampshire: Gower Publishing, pp. 11-23.

Clarkson J., Coleman R., Hosking I., Waller, S (2007). *Inclusive Design Toolkit*, Cambridge: Engineering Design Centre.

Coleman R., Clarkson J., Dong H., Cassim J. (2007). *Design for Inclusivity*, Hampshire: Gower Publishing.

European Commission (2006). *Build for All Reference Manual* http://www.build-for-all.net/ Accessed online: 9 September 2011.

Chamber of Architects of Turkey, Izmir Branch (2005) Principles for Elderly and Disabled People That Should Be Obeyed in Architectural Projects, *Design and Construction Journal*, 230 (20), 81-86.

Langdon P, Clarkson P J, Robinson P (2008). *Designing Inclusive Futures*, London: Springer.

Langdon P, Clarkson P J, Robinson P (2009). *Designing Inclusive Interactions*, London: Springer.

Mullick A. (2001). Universal Bathrooms, In *Universal Design Handbook*, Preiser F.E.W., Ostroff E. (Eds.), New York: McGraw-Hill, pp. 42.1-42.24.

North Carolina State University (NCSU) (2000). *Affordable and Universal Homes: A Plan Book*, Raleigh: North Carolina State University Press.

North Carolina State University (NCSU) (2001). *Gold, Silver and Bronze Universal Design Features in Houses*, Raleigh: North Carolina State University Press.

North Carolina State University (NCSU) (2006). *Residential Rehabilitation, Remodelling and Universal Design*, Raleigh: North Carolina State University Press.

Ostroff E. (2001). Universal Design: The new paradigm, In *Universal Design Handbook*, Preiser F.E.W., Ostroff E. (Eds.), New York: McGraw-Hill, pp. 1.1-1.12.

Savut Y. (2007) Bathroom and Kitchen Design Principles for Elderly Users, Chamber of Architects of Turkey, Ankara Branch, Dosya 04, *Bulletin* 46, 28-44.

Tezel, E. A Study on Usability Problems of Elderly Users in Bathrooms (2005). *Öz-Veri Journal* 2 (1), 477-499.

European Usability Handbook (1995). Disabled People's Federation of Turkey Publishing, Ankara.

Wilkoff W.M., Abed L.W. (1994). *Practicing Universal Design*, New York: Van Nostrand Reinhold.

Universal Bra for Women in Developing Nations: The Peace Bra

Doniece Bolds

College of Textiles, North Carolina State University, Raleigh NC 27695 (undergraduate student)

Katherine Henry

College of Textiles, North Carolina State University, Raleigh NC 27695 (undergraduate student)

Julisha Joyner

College of Textiles, North Carolina State University, Raleigh NC 27695 (undergraduate student)

Dr. Kate Carroll

Assistant Professor

Textile and Apparel Technology and Management

College of Textiles, Box 8301

North Carolina State University

Raleigh, NC 27695

e-mail: katecarroll@ncsu.edu

Dr. Carroll teaches in the fashion development program in the College of Textiles at NC State. Her research involves utilizing research and teaching methodologies which incorporate a holistic approach to the study of clothing for under-served populations; helping all people improve their health, well-being and overall quality of life through intelligent and inclusive clothing design, and using historic and cross-cultural models as inspiration for clothing for health and well-being.

Dr. Julie Willoughby

Assistant Professor

Department of Textile Engineering Chemistry & Science

Fiber and Polymer Science

North Carolina State University

e-mail: jacrowe@ncsu.edu

Dr. Julie Willoughby, earned her BS in Chemical Engineering at the University of Kentucky in 1992 and her PhD in Chemical and Biomolecular Engineering from North Carolina State University in 2007. From 1988 to 2002, she worked at Dow Corning Corporation in roles varying from process, product, and new business development to production management of silicone-containing polymers for coatings, textiles, and personal care products where robust process chemistry and material design were part of the infrastructure. Her work and leadership resulted in six key achievement awards for manufacturing, quality, business and technology innovation. Prior to joining NC State faculty, she was the lead scientist and project manager for barrier coatings at Meadwestvaco where she implemented multiple pilot-scale and full-scale (on-machine) coating innovations. Her research thrusts are in the areas of surface chemistry, surface dynamics and transport

phenomena for nonwoven applications and processing, tissue engineering, and utilization of renewable resources as feedstock for advanced materials.

Dr. Russell E. Gorga

Associate Professor

Department of Textile Engineering Chemistry & Science

Room #3304

North Carolina State University

2401 Research Drive

Raleigh, NC 27695-8301

919-515-6553

email: regorga@ncsu.edu

Dr. Russell E. Gorga is Associate Professor and former Program Director in Textile Engineering at NC State University and a member of the graduate faculty in the Fiber and Polymer Science program. He has affiliate appointments in both Materials Science and Engineering and Biomedical Engineering. Russell is currently involved in creating composite nanofibers that can be used for applications such as tissue scaffolds (for regenerative medicine), antimicrobial fabrics, and strain sensing applications. His research interests include nanoparticle / polymer composites, melt spinning and extrusion, scale-up electrospinning, and interfacial properties between polymers and particles. In 2010, Russell received the “Professional Progress in

Engineering Award" from the College of Engineering at Iowa State University. In 2007, Russell won the NC State University "Outstanding Teacher Award" and was inducted into the Academy of Outstanding Teachers.

Universal Bra for Women in Developing Nations: The Peace Bra

Doniece Bolds[1,+], Katherine Henry[1,+], Julisha Joyner[1,+], Katherine Carroll[2,], Julie A. Willoughby[1], and Russell E. Gorga[1]*

+Equal contributions to original research project

*To whom correspondence should be sent: katecarroll@ncsu.edu

[1] Department of Textile Engineering Chemistry & Science, Fiber and Polymer Science, College of Textiles, North Carolina State University, Raleigh NC 27695

[2] Department of Textile and Apparel Technology and Management, College of Textiles, North Carolina State University, Raleigh NC 27695

Abstract

The Peace Bra was created to facilitate independence among women in developing regions of the world by providing a garment that has potential to imbue the wearer with physical, emotional, cultural and economic stature. The concept of a bra has a variety of meanings in different parts of the world. For example, in Fiji and Kenya, wearing a bra means having dignity, a sense of protection and to a certain extent, empowerment. Due to low wages and lack of availability, it is almost impossible for women in developing regions to currently afford a bra. For this reason, the Peace Bra was conceived and a prototype developed. This paper aims to explain the importance of bras in

developing nations and show the stages of development of the universal bra, known as the Peace Bra.

1. Introduction

The idea of the Peace Bra was inspired by the efforts of a charity organization, “Project Uplift!” which collects and donates bras to women in the Philippines, the Solomon and the Fijian Islands (Project Uplift!, 2012). The bras that are donated are often the only bra that these women will ever own. Although this organization collects and distributes a multitude of bras, the sizes that some of these women need are not readily available. Thus, the idea of the universal, economical “Peace Bra” was born. The scope of this project extends from developing a concept and engineering the initial design iteration, to planning for implementation of the bra as a sustainable enterprise by local producers by allowing for choice in materials and processes most readily available to their situation. The intent is to create a completely self-sustaining process, where outside intervention is not necessary except in extreme circumstances. The goal is not to muddy the local economy with expensive imports or philanthropic donations, but to foster and develop an already established garment industry. The idea behind the Peace Bra is to provide a cheap, universal alternative bra that will be affordable to all women, no matter their socioeconomic status or size.

The supply chain will start with the raw material; cotton. Although this crop is grown all over the world, countries such as Fiji and Kenya typically import garment-use cotton. The other raw material, hemp, can be harvested locally and spun into a cabled yarn. The imported cotton fabric can be cut and sewn at low-tech local manufacturers, where the hemp will be attached to the bra. Within this simple model, decisions can be made at the grassroots level as to colour, finish and other design decisions. Women will be able to customize the bra and adjust it to fit a wide variety of sizes. The bra is designed to be a

sturdy and comfortable working garment that will support many local women in their daily lives – a true universally-designed garment.

2. Problem

Throughout history, the true purpose of bras has been disputed and their necessity as a purely functional garment challenged. Some have argued that bras were created to restrict femininity and others claim the opposite; that bras were created to give a woman's image an overtly sexual appearance. In the United States, the medical community was instrumental during the late 1800's in advocating the use of the brassiere to improve women's health, specifically in the reproductive areas, and in correct posture development (Farrell-Beck, Poresky, Paff and Moon, 1998). In today's economically stable societies, bras are typically fashion or sports-focused. However, this is not the case for women in Fiji and Kenya. Research has shown that the wearing of a bra in developing countries benefits women in a number of ways. The bra has been shown to increase the comfortable range of motion through the support and containment of the breasts. The garment also has several health benefits including: a reduction of back pain from the strain of the weight of large breasts; a reduction of skin rashes caused by excess sweat trapped under the breasts, and a lower rash transfer rate between nursing mother and child. Conversely, the absence of a bra serves as a social barrier and in some countries as a catalyst for rape. In countries where the average daily wage ranges from USD 1.50-4.50, it is almost impossible for women to afford bras of the same type and quality as those worn by women in highly developed countries (E. Birks-Mitchell, personal communication, 2010).

Due to the increased complexity of today's modern bras, few companies will take on a large range of sizes. For example, in today's

retail environment, the size for a push-bra at Victoria's Secret can range from 32AA to 38DD. Therefore, women with cup sizes outside the standard margin are forced to pay more for specialized bras. Furthermore, as bra prices increase without significant consumer resistance, lower income groups are forced to go without this necessary undergarment. This concept is especially true for under-privileged women in developing regions. Access to proper sizes is not always an option, and even when it is, the cost is usually too high. An average bra can cost around forty dollars in the U.S., whereas the average daily pay for women in Fiji is about USD 1.50. In Kenya the average salary for a skilled worker is around USD 61 per month. Buying a bra is not feasible when trying to maintain a family, a residence, and possibly more. A bra is a lower priority than food and shelter; therefore women on this type of income frequently just go without bras. For women who are performing some type of physical work, there are ergonomic implications in both agricultural and cottage industries within developing countries (Wisner, 1985).

The health risks associated with not wearing a bra can be substantial. Women who do not wear bras or wear improperly fitted bras are at risk for back injuries. This is due to the weight of unsupported breasts, which force the shoulders forward and put a strain on the upper back. Since the spine is responsible for so many bodily functions, strain on such an area can radiate to problems in digestion, respiration, headaches, and more (Baker & Cameron, 2009). Furthermore, breast pain due to strained, unsupported ligaments called mastalgia can develop from unsupportive bras, especially during exercise (WebMD, 2012). While proper diet and vitamin supplements can help, a well-fitting bra is one of the treatments for mastalgia.

Social stature may not seem to correlate with bras, but for women in economically struggling cultures, a bra is seen as a sign of wealth. Since a bra can cost several weeks' worth of wages, owning a bra can be a sign of higher status. In Kenya specifically, women believe that the lack of a bra brings more attention to a female than wearing a bra. This brings on more male attention, which Kenyan women believe can cause a rape attack to occur. If a woman were to have a bra they believe she would be less likely to be attacked in any way by a man (Baker & Cameron, 2009; Lindow, 2009). In the United States and most developed countries, a bra is not perceived so much as a safety blanket but just a garment that is put on as part of women's everyday accoutrements. If a bra can help reduce the amount of rape cases in Kenya and Africa as a whole, then an affordable bra might help to change a culture and its attitudes towards women.

A bra can also be seen as a symbol of social empowerment. In many developing countries, it is often necessary for women to breast feed well past a child's infant stage due to lack of access to clean water. While breast feeding, a woman can leak, and without a proper bra and protection, this leakage is impossible to hide, potentially developing into problems for both the woman and her nursing child. It becomes challenging for a woman to hold a public job, let alone venture outside the home due to social stigma and embarrassment. Also, the lack of a bra can have serious consequences for a child. The excess moisture on a nursing woman's breast can get infected and can cause thrush, an oral yeast infection (Dugdale & Vyas, 2010).

3. Bra basics

Bras operate on two basic principles: encapsulation (everyday fashion-type bras) and compression (sports bras). Most encapsulation-type bras consist of the same basic parts: cups, underwire, back wings,

straps, a centre gore, padding, and fasteners. These parts are discussed below and shown in Figure 1.

Figure 1 – The modern bra and its components

Cups – the cup is the part of bra which covers the breast. The cups of the bra can be made out of many materials and can be created through cutting and sewing separate pieces of material, and through moulding a single piece of material into shape.

Underwire – underwire is a piece of flexible wire used in the base of a cup which adds support to the bottom of the breast. Underwire is commonly used in push-up bras because of the added support but many users complain that it is the most uncomfortable part of the bra.

Back wings – the back wings are pieces of fabric originating from the side of the cup around to the fastening in the back. This component can vary in amount of stretch, width, and fastening type.

Straps –straps rest on the shoulders and connect the top of the cups to the top of the back wings. The straps place stress on the shoulders and can add strain to the back but aid in lifting and supporting the

breasts. Straps can be rigid or stretchy. To make the bra more universal, adjustable straps were developed in 1930.

Centre Gore – the centre gore connects the cups of the bra and rest on the sternum between the breasts. The centre gore is more important for women who have ample space between their breasts because it serves as a spacer so that the breasts look symmetrical. Centre gores can be stretchy or rigid; however, rigid gores offer more support. The width of the centre gore can vary and helps hide the bra when wearing low cut shirts.

Removable Pads – removable pads allow the wearer to alter the size of the bra on a daily basis. Pads are used for many reasons including hiding the contour of the nipple, hiding irregularities of uneven breasts, and giving the appearance of larger breasts. Padding can be stand-alone but usually is inserted in-between the fabric of the cups through slits.

Fastener – in order to put on and take off the modern bra, some sort of fastener is required and can be located at the back or front:
Hooks and Eyes –flat hooks latch on to a small circle sewn into the back wing of the bra. They are typically made out of metal.
Clasps – Clasps are identical fasteners turned opposite to each other. The dip in each fastener hooks on to the other. After the hooks are interlocked, they are turned to give a flat appearance. They are usually made out of plastic but sometimes can be made out of metal.

Sports bras operate by compressing the breasts to prevent or restrict movement that exceeds normal daily activity, such as running, jumping, and other sports requiring sustained vigorous lateral movement of the upper body. Sports bras can vary in the type of

support that they give, and can contain all of the elements of a fashion support bra or be a simple restrictive garment that is pulled on over the head and is designed to compress the breasts through tight fabric which prevents breast movement during activity. The wearing of a sports bra has also been linked to relief from mastalgia, due to its support of potentially weak suspensory ligaments which contribute to breast pain (Hadi, 2000).

4. Method

The Peace Bra project was conceived upon learning about Project Uplift, and deciding to not only design an innovative product for women in developing countries, but also contribute to the independence and economic development of a region. The design process used for the development followed Engineering Design theory as taught to a senior level Textile Engineering class at a state university in the U.S.A (Ulrich & Eppinger, 2008). The process includes establishing knowledge, developing concepts through criteria and constraints, and developing prototypes as specified in the following sections.

4.1 Criteria development

After thoroughly researching the needs of women in developing countries and the various types of technologies associated with the modern bra, certain criteria and constraints were established to define the usefulness of an economical universal bra. After research and interviews with the personnel associated with Project Uplift, it was determined that the most important aspects of a universal bra are strength, comfort and adjustability. The imported bras that women are utilizing in developing countries are a viable option, but they do not always fit correctly, have lost their structural integrity, or are detrimentally uncomfortable. Improving on these areas is key in order

to develop an economical bra as a competitive option. Detailed design criteria and constraints are outlined in Tables 1 and 2.

Criteria	Importance	Description
Adjustability	5	The bra needs to be adjustable in the bust and in the cup size so that women of various sizes can potentially wear the same bra
Air Circulation	3	The climate in Fiji and in most parts of Africa is hot and humid. The bra should allow air to pass through to the skin
Comfort	5	The product should allow the user to perform daily activities without hindrance due to pinch points or irritation of the skin. The comfort level should be better or the same as the average bra.
Antimicrobial Properties	2	The bra should not pass or facilitate viruses, or any type of harmful bacteria.
Moisture Wicking/ Absorption	2	The bra should be able to absorb and wick sweat and leakage (of the breasts) due to nursing, or provide somewhere to hide a pad to prevent leaks.
Attractiveness	2	The bras should be attractive. The main goal is functionality but it should be culturally acceptable.
Simplicity	3	The steps to wear the bra should be appropriate for women of many levels of cognitive development to use.

Strength	5	The bra should be able to support a heavy breast without compromising materials.

Table 1 – Design Criteria (5 is highest priority)

Constraints	Importance	Description
Cost Effectiveness	5	The product should be affordable for women in the countries with the least developed economic system
Available Technology	5	The resources needed to create the final product must be able to be worked by hand if necessary
Easy to Clean	4	Washing machines and dryers are not readily available in these cultures, so these bras must be able to be washed by hand

Table 2 – Design Constraints (5 is highest priority)

4.2 Concept Ideation

Several sessions were held involving brainstorming to come up with three alternative ideas that were deemed appropriate according to the criteria and constraints listed above. Using existing types of bras and ideas from other garments and accessories from both Western and ethnic cultures, the three alternatives were developed at detailed sketches for evaluation:

4.2.1 Adjustable Sports Bra

The adjustable sports bra allows for the wearer to adjust the bra vertically at the shoulders and horizontally in front of the breasts. This

provides for lift and separation of the breasts for larger busted women and a spacer for smaller busted women. In order to be able to adjust the bra, small notches or knots would be placed on one breast cup while the matching holes would be placed on the other breast cup. The back would have a racer back design which relieves some of the stress of the bra from the back and evenly disperses the weight across the shoulders. The sports bra design was suggested because the sports bra provides support, comfort and is easy to wear.

On the inside of the bra, slits will be placed in both “cups” in order for pads to be placed inside the bra for lactating mothers or for women that want to appear bustier. The bra will be made of at least two layers of fabric so that lactating mothers will not leak easily through the fabric. The bra will be made of one continuous piece of material in order to cut costs and make the design easier as well easy for the wearer to put on. The bra will be made of a natural fibre that will contain hemp wrapped in cotton underwire in order to provide support and lift.

4.2.2 Sari Wrap Design

The Sari Design is modelled after the current saris used in India. The wrap features an alternating basket weave made out of cotton (suggested), cotton covered hemp straps, pockets for inserts for nursing, and reinforced slits along the outer rim for adjustability. The ends of the bra taper for better adjustability.

4.2.3 Scrunchy Bra

This design’s strength lies in its simple construction. One long piece of fabric is used and can be adjusted to any cup size and chest circumference through the use of ties, based on the scrunchy type of hair band. The wearer will place the middle of the garment at their chest, with three ties at intervals. They would then wrap the ends

around their back, criss-cross style, and bring them back over the shoulders. The ends of the straps will attach to the top of the “cups” by a tie-system. One of the bands should sit between the breasts and the other two just outside the breasts. This creates adjustable “cups”. The scrunchy ties would be made of cotton with hemp braid inside for strength.

Table 3 shows a comparison of contemporary bras, as well as our three conceptual designs, for functionality in the form of a Pugh matrix. Our conceptual designs include an adjustable sports bra, a sari wrap, and a scrunchy bra. Each has its own merit and features a different inspiration. We ranked them according to our criteria and constraints. The following table highlights the logic through which we ranked each concept, with a description of percentages after.

Pugh Matrix

		Sports Bra		Regular Bra		Design 1 Adjustable Sports Bra		Design 2 Sari Wrap		Design 3 Scrunchy Bra	
Criteria	Percentage	Rank	Percentage	Rank	Percentage	Rank	Percentage	Rank	Percentage	Rank	Percentage
Adjustable	25%										
Universal	15%	3	0.45	1	0.15	4	0.6	4	0.6	4	0.6
Alterable	10%	1	0.1	3	0.3	3	0.3	5	0.5	5	0.5
Air-Circulation	10%	4	0.4	2	0.2	3	0.3	3	0.3	3	0.3
Comfortable	15%	4	0.6	3	0.45	4	0.6	4	0.6	4	0.6
Antimicrobial	10%	2	0.2	2	0.2	4	0.4	4	0.4	4	0.4
Moisture Wicking	10%	3	0.3	1	0.1	3	0.3	3	0.3	3	0.3
Appearance	5%	2	0.1	5	0.25	3	0.15	3	0.15	1	0.05
Ease of use	8%	5	0.4	3	0.24	3	0.24	2	0.16	4	0.32
Strength	15%	2	0.3	4	0.6	4	0.6	4	0.6	3	0.45
Easy to Launder	2%	5	0.1	1	0.02	5	0.1	5	0.1	5	0.1
Total:	100%		2.95		2.51		3.59		3.71		3.62
Rank:			5		4		3		1		2

Table 3 – Pugh matrix ranking each design (lowest rank number indicates most successful design according to matrix)

Adjustability was given the greatest percentage weight because in order to create a one- size-fit-all bra, a bra had to be easily adjustable in order to fit several variations in breast size and shape. If the bra is not easily adjustable then the bra will only be able to fit a limited amount of people. Our goal is to reduce costs as much as possible and

in order to do that, a bra that can fit a larger variance in sizes would help save money.

Comfort was next in weighting because many of the women perform physical work, doing field labour and other agricultural activities. The bra has to be able to be worn for several hours and not feel painful or cause irritation to the skin or body. Strength is also equally as important as comfort because as previously stated, many of the women work hard labour jobs. The bra has to resist against tears and other abrasions as well as be able to support the varying sizes of the breasts. If the breasts are not properly supported, this can have long term affects on the body such as breast tissue damage and strain on the back. With the women constantly moving for several hours a day, good support is an essential part of the bra.

Air circulation is considered important because many developing countries are located close to the Equator and have very hot and humid climates. Therefore, the women sweat heavily and need a bra that can keep cool air coming in so that sweat build up does not impede energy and restrict activity. It is also important for skin/air circulation to prevent rashes brought on by excessive heat and moisture. Antimicrobial concerns are linked to air circulation and moisture. Many breast feeding mothers lactate onto their bras and clothing and the build up of lactation can cause rashes to form on the nipple of the mother. This rash can also pose problems for the nursing baby in that medical issues such as thrush can easily occur in these types of circumstances. Antimicrobial properties should restrict these types of issues. Moisture wicking properties are important because of the hot and humid climate. We do not want the bra to hold the moisture on the skin but to be able to remove the moisture off the

body. A build up of sweat can cause very itchy and painful rashes under and between breasts.

Ease of use (simplicity or comprehension of use) is important but not a priority. We want the women to be able to put the bras on easily without having to struggle or having to read directions in order to intuitively understand how to wear or make the garment. Similarly, an attractive appearance is a useful attribute because that is typically how people choose their clothing but it is not a high priority in the weighting. The bra may be visible and can be customized with dyes and other decorative techniques if desired. Ease of cleaning is an important property so the bras are designed and built to be hand washed and air dried. Since clothes are already hand washed in many developing countries there is no reason to try to change the laundering process.

4.3 Concept Refinement

After careful consideration and sponsor feedback during the concept ideation process, we isolated the qualities of each concept that stood out as exceptional and integrated them into a single refined concept. This final design was based primarily on the scrunchy bra but encompassed some characteristics from each design. Combining these attributes utilized the best of all concepts and moved the process closer to a final prototype. A detailed sketch can be seen in Appendix 1. Even though the “scrunchy” bra was the design of choice, one problem still remained. The tie in the front was vulnerable to break, exposing a lack of structural integrity. Reinforced hemp wrapped with cotton fabric was added to help with this integrity.

The final, refined concept utilizes the design of the scrunchy bra with the universality of the sari design and the support of the adjustable

sports bra. The scrunchy bands' mobility to adjust cup shape and size assist in fit for a variety of sizes. Cotton-wrapped hemp underwires support and adjust length of fabric by gathering, also helping with cup shape and support intensity. The scrunchy band on the back adds support for heavier breasts.

This design is simplistic in the sense that a long piece of fabric is used and therefore can be adjusted to any chest size. The wearer will place the middle of the garment at their chest, with three elastic bands ("scrunchies") at small intervals. They then wrap the ends around the back, criss-cross across the shoulder blades and small of the back, and then pull the ends over the shoulders. Two loops strategically placed at the top of the "cups" secure the ends by a tie-system. One of the scrunchies should sit between the breasts and the other two just outside the breasts. The two outer "scrunchies" can be slid loosely, and then tightened by hemp drawstrings to create adjustable "cups". With the advantages combined, this new design was dubbed "Peace Bra" and a prototype was constructed, together with specifications for construction. Appendix 2 shows the final prototype adjusted to two different configurations for different bust sizes. This prototype has also been hand tie-dyed to add colour and decoration to the bra.

4.4 Evaluation

We conducted a live wear study, which asked subjects to assemble the bra on their body, perform a set of physical exercises, and then rank each characteristic on a scale of 1-5, with 5 being the highest. The physical exercises included bending and stretching to encompass a range of motion, and then ten minutes of intense exercise, which varied from Wii Just Dance (Nintendo Games, 2012) to P90X (Beachbody LLC, 2012) displays a breakdown of the rated metrics. The total number of participants was 6, a small but diverse

representation in terms of chest size and shape, with cup sizes ranging from a B to a DD. Breathability, strength, moisture absorption and comfort were all ranked 4 and above, indicating these attributes were above satisfactory for the user. Fit and ease of use (how simple is it to put on and take off) ranked slightly lower. We speculated these results stemmed from the deviation in design from a "normal bra." Indeed, the fit and assembly is quite different from traditional bras, however we believe the design would be comparable in ease of use to cultures that have not been accustomed to one dedicated style.

Mild Exercise Data

	Average	Standard Deviation	95% Confidence Interval
Breathability	4.83	0.408	0.428
Strength	4.50	0.548	0.575
Moisture Absorption	4.50	0.548	0.575
Ease of Use	3.17	0.408	0.428
Comfort	4.67	0.516	0.542
Fit	3.67	0.516	0.542

Intense Exercise Data

	Average	Standard Deviation	95% Confidence Interval
Breathability	4.667	0.516	0.542
Strength	4.000	0.000	0.000
Moisture Absorption	4.500	0.548	0.575
Ease of Use	3.333	0.516	0.542
Comfort	4.667	0.516	0.542
Fit	3.667	0.816	0.857

Table 4 – Wear-test results

4.5 Implementation

Ideally, this garment would be completely sustainable from start to finish. Local land could be cultivated to yield cotton and hemp crops, if these are not currently grown, and assist in agricultural development. Local manufacturers could spin and weave the cotton, while the hemp could be spun and braided at another local facility. The garment could then be assembled either by an existing supplier or by a start-up company; even a “cottage” operation. Colour can be added using natural local dyes in the process, or other types of indigenous decoration. The key is that nothing is imported or exported outside of the local area. Creating an economical, sustainable process is less beneficial if the garment has to travel 2500 miles before completion. Supporting local economies is an important factor of this product. Advanced skills are not necessary for any of the steps in the creation process, so it could potentially create jobs for the unskilled worker, a major socioeconomic faction of many developing regions. An added benefit to local production is that there is more room for tailored adjustment. If a woman is in need of a particularly large size, the supplier can feasibly accommodate that request, whereas a large, global supply chain could not.

The cost of manufacture is roughly estimated to be USD 5. That was approximately the cost of materials to make each prototype, not including labour. However, since hemp cannot be legally grown in the United States and most cotton is not local, the cotton and hemp used was imported, and therefore has the added cost of transportation. It can be assumed that locally grown cotton and fairly priced labour should not increase the cost of the Peace Bra to more than USD 5, dependent upon region and supply chain.

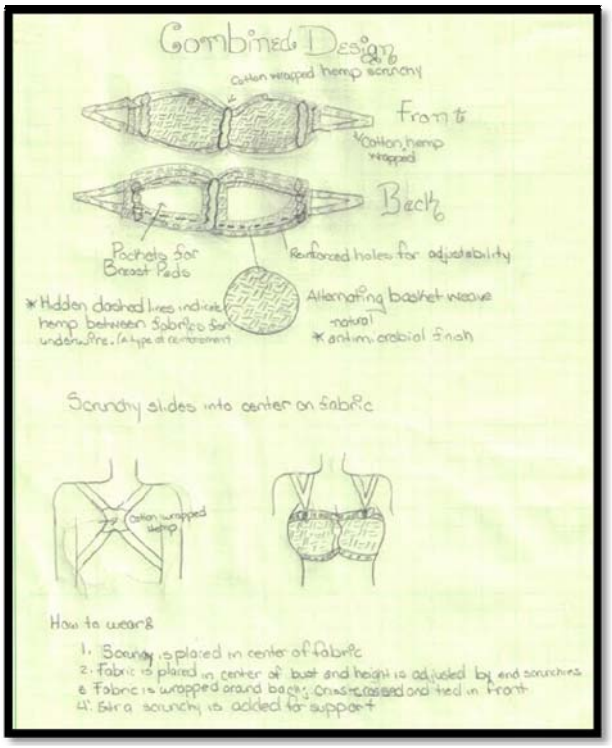
5. Conclusions and Recommendations

The need for universally-designed, affordable bras is a global issue among women. Bras provide support to the back, neck and shoulders, as well as serve a cultural purpose. While bras are typically a western ideal, many developing regions support the notion to improve women's health and status in society. Criteria and constraints for each specific climate and economic environment must be identified in order to define the target market. Current designs integrate a plethora of components, adding cost and complexity, two aspects we avoided in our final design. The Peace Bra will be an available, inexpensive alternative to contemporary bras, without sacrificing support or function.

After presenting the final iteration as part of the requirements for the class project, spectator input suggested that there is a need for this design in non-struggling economies, as well as the regions that had been earlier identified. This bra could be utilized for women who cannot use the traditional underwire system, yet still need support. In its current condition, however, the bra is not designed for these economies. Due to the fact that our functional bra design was developed with cost and convenience in mind, the materials were selected for women who live in humid climates with limited resources. To "Westernize" the bra, research into synthetic substitutes and bulk reduction is highly recommended.

6. Appendices

Appendix 1 – The Peace Bra



Appendix 2 – Bra as placed for wearing on a dress form showing customized wearing options for two different sized figures

7. References

Baker, E. (2010). Project Uplift Co-Ordinator. Interview by Julisha Joyner (September 16, 2010).

Baker, E. & Cameron, M. (2009). Uplift Fiji: Exploring the differences bras make among Fijian women.

Beachbody LLC. (2012). P90X Extreme Home Fitness. Available online at http://www.beachbody.com/product/fitness_programs/p90x.do (accessed July 5, 2012)

Birks-Mitchell, E. Interview by Doniece Bolds (October 13, 2010).

Cardon, D. Natural Dyes: Sources, Tradition, Technology and Science. London: Archetype Publications, Ltd., 2007.

Dugdale III, D. C. & Vyas, J. (updated 8/24/2011). Thrush. Available online http://www.nlm.nih.gov/medlineplus/ency/article/000626.htm (accessed July 5, 2012)

Farrell-Beck, J. & Gau, C. (2002). Uplift: The Bra in America. Philadelphia: University of Pennsylvania Press.

Farrell-Beck, J. Poresky, L., Paff, J. and Moon, C. (1998). Brassieres and women's health from 1863-1940. Clothing and Textiles Research Journal, 16(3), 105-115.

Gounder, R. Dimensions of Conflict and the Role of Foreign Aid in Fiji. Department of Applied and International Economics, 2005.

Hadi, M.S.A.A. (2000). Sports brassiere: Is it a solution for mastalgia? The Breast Journal, 6(6), 407-409.

How is a Sari Made. http://www.puja.com/sari/made/made.htm (accessed November 2010).
Jacob, M.P. Brassiere. Patent 1115674. November 1914.

Lindow, M. (2009). South Africa's Rape Crisis: 1 in 4 Men Say they've done it. TIME magazine, 2009.

Nintendo Games. (2012). Just Dance. Available online at http://www. nintendo .com /games/detail/lsuOIrpVD ZGNKP-14iVQumsPxZ8e_LmR (accessed July 5, 2012)

Project Uplift! (2012). About Us. Available online at http://www.upliftbras.org. (accessed July 2, 2012).

Ulrich, K.T. & Eppinger, S.D. (2008). Product Design and Development. Columbus, OH: McGraw-Hill/Irwin.

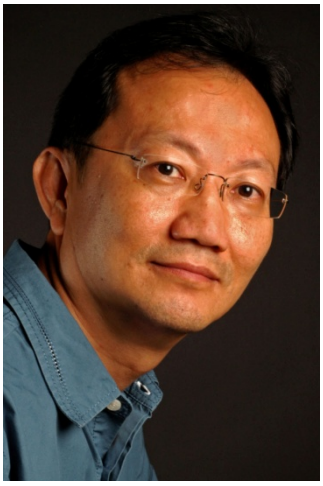
U.S. Dept. of State. (February 25, 2004). Bureau of Democracy, Human Rights, and Labor: Kenya. Available online at http://www.state.gov/g/drl/rls/hrrpt/2003/27733.htm (accessed October 2010).

WebMD. (September 9, 2011). Women's Health: Breast Pain (Mastalgia). Available online at http://women.webmd.com/tc/breast-pain-mastalgia-topic-overview (accessed July 3, 2012).

Wisner, A. (1985). Ergonomics in industrially developing countries. Applied Ergonomics, 28(8), 1213-1224.

Zhang, J. & Zhang, J. (2010). Effect of refined processing on the physical and chemical properties of hemp bast fibers. Textile Research Journal, 80(8), 744-753.

Live Well Collaborative: Creating Active Ageing Solutions through 'Naive Innovation'



Siak Koon, Goh

Centre Director

Live Well Collaborative Ltd,

Architecture Design & Environment Cluster,

Singapore Polytechnic

500, Dover Road, Singapore 139651

e-mail: siakkoon@sp.edu.sg

Siak Koon received his Bachelor of Architecture from the University of Newcastle Australia in 1986. He has worked in Sydney on residential and commercial buildings and in Singapore with Jurong Town Corporation, before joining Singapore Polytechnic (SP) in 1996 where he has been a member of the management team overseeing the development of course content, student matters and facilities. He was invited to helm the Live Well Collaborative - Singapore in 2010 as the Executive Director with the responsibility for setting up the collaborative between Singapore Polytechnic and Procter and Gamble.

The Live Well Collaborative – Singapore (LWC-S) is an extension of the Live Well Collaborative in Cincinnati, which is a business-academia partnership between Procter and Gamble and University of Cincinnati. The LWC-S has to date completed nine paid studios collaborating with MNCs and SMEs such as Boeing, Procter & Gamble, Kraft, Hill-Rom and Foresight Technologies. LWC-S is also leading one of the four themes, Active Ageing, for the Social Innovation Project (SIP) Module for all year two students and the Living Laboratory for the Elderly in SP.

Cheryl, Wee

Education Advisor

Singapore Polytechnic, Department of Education Development

500, Dover Road, Singapore 139651

e-mail: cherylwee@sp.edu.sg

Cheryl received her Masters of Education from the University of Western Australia in 2011. She has worked in the Department of Education Development in Singapore Polytechnic (SP) as an Education Advisor since 2006. In the department, she was involved in the implementation of the CDIO initiative in SP's Engineering courses and most recently, involved in spreading Design Thinking in SP. Together with a team of staff, she conducted staff development workshops on Design Thinking and also produced a Design Thinking Toolkit aimed to equip lecturers with easy to use tools to apply Design thinking in the classrooms and in projects.

In 2010, Cheryl was invited to join Live Well Collaborative - Singapore (LWC-S) as one of the staff facilitators. She has since facilitated a number of studios including 3 LWC-S Boeing Studios and also conducted a workshop on Design Thinking for Shanghai-Singapore International School. As a staff member of the Department of Education Development, Cheryl is currently involved in the

implementation of the Social Innovation Project (SIP) Module for all year two students in SP. She is also looking forward to facilitate the upcoming 4th Boeing Studio with LWC-S.

Live Well Collaborative: Creating Active Ageing Solutions through 'Naive Innovation'

Goh Siak Koon and Cheryl Wee

Live Well Collaborative: Singapore, Innovillage, 500 Dover Road, Singapore 139651

Abstract

The Live Well Collaborative – Singapore (LWC-S) is an independent innovation research centre which tests and develops product design for consumers aged 50 and above in Asia. LWC-S works with Multinational companies to select specific projects which are then researched and developed with multi-disciplinary teams of students from Singapore Polytechnic of ages 17 to 20 years. The students come from different disciplines ranging from Architecture, Business, Communications, Design, Life Sciences to Engineering, and bring `Naïve Innovation ' to the process – a term we have coined at Live Well Collaborative to refer to the youthful naivety of always asking difficult questions (`why this, why not that?') when carrying out research and testing a product. The students' technical background and familiarity with current trends provides fertile ground for the creation of original primary research material and thoughtful, innovative product design. This article focuses on the design thinking process that buttresses all LWC-S projects.

1. Introduction

The Live Well Collaborative – Singapore (LWC-S) is an independent innovation research centre focused on revolutionising product design and development for consumers aged 50 and above (50+) in Asia. Located at the Singapore Polytechnic (SP), LWC-S is the first LWC site in Asia Pacific and the second in the world. Sharing similar visions on issues relating to the ageing population in the Asia Pacific region, Live Well Collaborative, Cincinnati, USA has partnered with SP to set up LWC-S in Singapore. Launched in September 2010, LWC-S is grounded in two unique but related disciplines, as described in the LWC-S website (n.d):

1. Consumer-based product research that combines anthropologic and psychological tools to provide a deep understanding of consumers' unarticulated needs. The insights gained from this deep dive research are used to identify the strongest product and service concepts for further work.

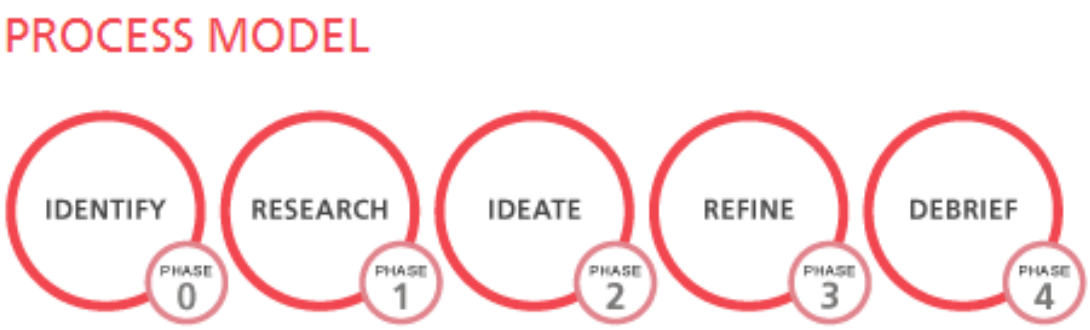
2. Design Thinking Principles that convert strategy and consumer insights into actionable products and services.

LWC-S operates on a collaborative model that teams polytechnic lecturers with students on research projects to conceptualise solutions for the 50+ using the Design Thinking process. Interested clients sign up with LWC-S as members before a project is started. The term 'naive innovation' was created from a belief that students of the ages of 17-19, having none of the impediments on quality that adults sometimes have, are better able to make a difference in the lives of the 50+ with their solutions.

To define what design thinking is, IDEO's current CEO Tim Brown explains in the IDEO's website that:

Design thinking is a human-centred approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success. (IDEO, n.d.).

In each LWC-S studio project, students are guided through the LWC-S design thinking process via four phases as shown in figure 1 below.



Phase 0

Before the project

During the planning stage of a project the member identifies the problem space and collaborates with the LWC on the project brief.

Phase 1 – 3

During the 10 week quarter

The research team focuses on obtaining knowledge about the topic, translates insights to concept ideas and tests and refines concepts to meet the needs of the member.

Phase 4

After the project

Possible future opportunities regarding the project results for the member and LWC. This should also be discussed in Phase 0.

Figure 1: Design Thinking Process Model of LWC-S

The process is adopted from Live Well Collaborative – Cincinnati. It introduces rigorous thinking, and also provides a clear direction for students and clients to embark their studio project.

2. LWC-S Studios

With every member signed up, LWC-S spins off a maximum of 2 studios projects per year. The structure of LWC-S studios is closely aligned to the design thinking framework. Studios are normally 10 weeks (or 45 hours) long and focused on new product and service developmental projects. Every studio project that we embark on harnesses the vast potential of multidisciplinary problem-solving and innovation through active participation by lecturers and students across diverse disciplines. This is extremely important because this allows a cross-pollination of ideas, exposing students to different perspectives and providing them with opportunities to think broadly. Brown supports this approach in his book, Changed By Design (2009): "Though it is possible to operate as an individual, the complexity of most of today's projects is fast relegating this type of practice to the margins." He further adds that: "It is common now to see designers working with psychologists and ethnographers, engineers and scientists, marketing and business experts, writers and filmmakers. All of these disciplines and many more, have long contributed to the

development of new products and services, but today we are bringing them together within the same team, in the same space, and using the same processes." The following sections describe the phases of a typical studio project.

Phase 0

In phase 0, the project is scoped between LWC-S and the client. A project brief is written with an agreed budget. Lead investigators from the lecturers' team will be identified, together with 20 SP students from different disciplines.

Phase 1

Phase 1 of the studio project represents the start of the studio project. Students embark on the research stage with observational and interviewing tools and methods to find out in-depth information on their potential elderly users. This phase, sometimes also referred as the empathy study phase, is crucial to the project because students undertake a journey with the 50+ to understand their lives, thoughts, best and worst experiences. Students ultimately gain a deeper understanding of, and better empathise with, the 50+. In the context of design thinking, Brown (2009) supports this approach by observing that empathy "is perhaps the most important distinction between academic thinking and design thinking. We are not trying to generate new knowledge, test a theory, or validate a scientific hypothesis." Long hours of observation and interviews usually take place in obtaining this qualitative data.

Figure 2: Students interviewing elderly

Our students have ventured into the 50+ homes, and have spent time chatting with the 50+ in places where they commonly hang out. Some students have even invited the 50+ into the LWC-S studios. This phase has been crucial for the students to gain an understanding of both the desires and needs of the 50+. Students have discovered new insights and gained valuable knowledge from the stories on life that the 50+ have shared with them. Some students' were initially worried that most of the 50+ were irritable and would not want to open up to them. However, contrary to this belief, students subsequently realised that the 50+ loved to chat with them. Most 50+ were very open in sharing their responses to the students' questions. They were certainly more than happy to help out with the students' projects because they knew that the students were working on projects to improve the lives of the 50+. Given the time that they had on their hands, the 50+ were also simply happy to have the students' company. In LWC-S, it is clear that, although quantitative surveys are certainly used, qualitative research is the primary research method used in the studio projects. Brown (2009) has also agreed this (2009, p. 40). He mentions that: Insight is one of the key sources of design thinking, and it does not usually come from reams of quantitative data that measure exactly what we already have and tell us what we already know. With the huge quantity of data collected, students embark on a

clustering activity to group the data into common themes. This is followed by an identification of the insights and needs of the 50+. A persona is also developed at this stage where students decide on who their actual target 50+ users are. The persona will stay with them till the end of the project and will be a focus point when the students proceed to the later phases of the project.

Figure 3: Students clustering data from their empathy study

Phase 2

In phase 2, students generate as many ideas as possible based on the persona and various needs that have previously been identified. Hundreds of ideas are usually generated. These ideas are eventually narrowed down to several key concepts that are prototyped. In design thinking, designers called them 'Quick and Dirty Prototypes'. Quick and dirty prototypes are low-resolution prototypes that are meant to be completed fast and cheaply. The main objective of prototyping is to communicate the concept to users for the purpose of collecting feedback and also to invite discussion on further improvement. Prototyping at this stage is simple yet powerful. It does not involve any real technical implementation. Prototypes may be in the form of paper, cupboard, video, role-play, video, or a combination of a few methods that can be quickly put together. As Brown (2009, p. 68) explains: "Although it might seem as though frittering away valuable time on sketches and models and simulations will slow work down,

prototyping generates results *faster*…The faster we make our ideas tangible, the sooner we will be able to evaluate them, refine them, and zero in on the best solution." Once the prototypes have been done up, students gather feedback from potential users. LWC-S invites the 50+ back into the studios to co-create solutions while students present their concepts through their prototypes. As the prototypes are raw and cheap, users are encouraged to change and amend the prototypes as they please. At this juncture, students observe the interactions between their prototypes and the 50+ and evaluate whether their concepts have indeed met their users' needs.

Phase 3

As design thinking should be an iterative process, students should not hold on too tightly to their concepts. They often have to go back to the drawing board to refine and enhance their concepts. Once they feel that they have gathered sufficient feedback and positive responses from their prototypes, students will proceed to produce functional prototypes which will then be presented to the client. This marks the end of phase 3.

Phase 4

In this last phase, LWC-S reviews the outcomes of the studio and explores upcoming projects with the client.

3. Evaluation

Students gave positive comments at the conclusion of the studio project. One mechanical engineering student, Kaung Ko Ko shared the following on his experience from the Boeing studio project: "This project is way too awesome for me, I feel very happy and excited that I am able to work with students from multi disciplines. This project is different from the rest of the projects which I've worked in as we really

go out to understand our users before we jump into solutions. We next ideate and came up with 200+ ideas, build prototype and test them with our users. The Design Thinking process makes the project very real and meaningful. I hope that the elderly consumers will be able to use some of our ideas in their travel experience". (Live Well Collaborative - Singapore, 2012)

Another student, Abdur Rahman Bin Haji Mydin from the School of Design shared: "This is a very fruitful experience for me. This Boeing studio allows me to work with people with different disciplines. During brainstorming, we came up with ideas from different points of view but in the end, we blend them together to conceive something that is not just pleasing to the eye and at the same time mechanically feasible. It was fun doing the surveys, it teaches us to never assume anything of our users". (Live Well Collaborative - Singapore, 2012)

The key to the success of the studio projects depends on a combination of lecturer's facilitation, students' self-actualization and their motivation levels. These three success factors are closely related. Failure to facilitate the process will lead to a failure of the students' ability to self-actualize, which will lead to a drop in students' motivation.

4. Feedback from Partners

In the February 2011 issue of the Fast Company magazine, Pete Guard who is the Cabin-experience strategy leader for Boeing was interviewed on his partnership with LWC-S. Recognizing the fast growing aging passengers in Asia, Pete Guard has been collaborating with LWC-S to continuing improve the in-flight design for his aging passengers. When posed with the question for the reason of focus in Singapore and working with LWC-S, he answered:"Singapore is

moving a lot faster than the rest of the world. It's at the epicenter of a trend that's starting to play out – all the issues of mobility, assistance, and longevity. We'll work through their university systems and design schools to help develop projects that will give us a better idea how to support travellers around the planet." (Fast Company, 2011)

Vicki A. Cutis from The Concept Centre, Boeing has this to say after fronting 4 studios with LWC-S:"It is very important to understand the aging Asian market. Boeing is working with Live Well Collaborative in Singapore to get an understanding of who our future passengers are and how to better accommodate them. With the collaborative, we get the advantage of bright young minds, who know today's technology, solving problems for tomorrow's seniors. The students develop insights that highlight the culture and develop unique solutions. The final results are always an enlightening surprise". (Live Well Collaborative - Singapore, 2012)

5. Examples of Studios Work

5.1 Boeing Studio 1 – April 2011

The Door to Door Journey: The studio project provides holistic solutions to improve and maintain the positive experiences of baby boomer airline passengers as they age. The team journey with the "future" traveller to understand opportunities for travel improvement with the goal of making the "door to door" process easy and seamless for everyone.

Trips: Kuala Lumpur, Malaysia; Observation trip; 11-12 April 2011

5.2 Boeing Studio 2 – 14 Sep to 14 Oct 2011

Your Personal Space in the Sky: This second studio project provides holistic solutions to improve and maintain the positive experiences of baby boomer airline passengers. This studio refines and builds upon the findings of the first Studio. Students continue the journey with the "future traveller" to understand opportunities for travel improvement in the specific area of the personal cabin space.






Trips: Hanoi, Vietnam; Observation trip; September 22 - 23 2011

5.3 P & G Studio 1 & 2 – May to August 2011

Learning Pilot: Gen-Y and Baby Boomers (China 1+): For the 2 studio projects, the student teams partake in activities to understand the culture and lifestyles (values, desires, aspirations, habits and practices) of the Gen Y and Baby Boomers consumers in China. This includes a 12 day ethnographic study trip to Shanghai and Beijing to observe 24 local respondents.



Trips: Shanghai and Beijing China; Observation trip

6. Conclusion

LWC-S has set up a dynamic program which, in the past year and a half years, has facilitated several exciting and fruitful collaborative projects between the students and staff of Singapore Polytechnic and the MNCs who are our clients. Each project has led to the development of insightful primary research and the creation of some wonderfully innovative design solutions for specific problems. It has been an all-round success: the participating companies acquired valuable insights into the lifestyle and requirements of the aging population in Asia, and the staff and student benefitted from being involved in providing research and solution to real life problems and scenarios. This augurs

well for future projects. As the world population ages we at LWC-S in our own small way will continue to create the opportunity for students and staff to work with the elderly consumers to provide insights and solutions to their day-to-day requirements.

7. References

IDEO. (n.d). *About IDEO*. Retrieved March 28, 2012, from <http://www. ideo.com/about>

Brown, T. (2009). *Changed By Design: How Design Thinking Transform Organizations and Inspires Innovation.* United States of America: Harper Collins.

Fast Company. (2011). *Perfecting Your Flight Accommodations With Pete Guard of Boeing.* Retrieved March 28, 2012, from http://www.fastcompany.com/magazine/152/fast-talk-pete-guard. html

Live Well Collaborative - Singapore. (2012). *Testimonials.* Retrieved March 28, 2012, from http://www.livewellcollaborative.com.sg

Looking Back, Looking Forward: Interface, Interactions and Reactions from Different Technology Generations

Dr Christopher Sze Chong Lim
Research Fellow
Digital World Research Centre
University of Surrey
GU2 7XH
e-mail: s.lim@surrey.ac.uk

Dr Christopher Lim is a Research Fellow at the Digital World Research Centre, University of Surrey. Prior to this appointment, Chris worked as a Senior Researcher at Nomad-RDC, a Glasgow-based design consultancy. Trained as a product design engineer at the award winning Product Design Engineering (PDE) programme run jointly by the Glasgow School of Art and University of Glasgow, he was a teaching assistant and is now an adjunct lecturer in the department and with the University of Surrey. Chris' research interest in inclusive

design lies in the area where cognitive ageing, technological experience and Interaction design intersects. His other interests include design methodology and inclusive design education. He is also a Fellow of the Royal Society for the Arts, Manufactures and Commerce (RSA) and a member of Design Research Society.

Looking Back, Looking Forward: Interface, Interactions and Reactions from Different Technology Generations

Dr Christopher Sze Chong Lim

Digital World Research Centre, University of Surrey, GU2 7XH

1. Introduction

Services such as banking, shopping, travel bookings and communication provided via the Internet can benefit many people as it not only provides information but convenience and cost savings to its users. However these benefits are only available to those who are digitally connected and certain groups of society are excluded from these benefits because they do not have access to the Internet or find it difficult to do so. This could be due to a variety of reasons including social-economic, age-related abilities, attitudinal and user interface complexity issues. In light of an increasing ageing population, the engagement of older people in the digital age or e-Inclusion is of importance to both EU and the UK government. E-inclusion is defined by the EC ICT ministerial conference in 2006 as "inclusive ICT and the use of ICT to achieve wider inclusion objectives. It focuses on participation of all individuals and communities in all aspects of the information society. eInclusion policy, therefore, aims at reducing gaps in ICT usage and promoting the use of ICT to overcome exclusion, and improve economic performance, employment opportunities, quality of life, social participation and cohesion." (EU ICT Riga 2006). In the ministerial declaration, the improvement of ICT access for older people and people with disabilities were highlighted an important area. In the UK to support e-inclusion, various government initiatives such as Race

Online were set up to get people who are unengaged in particular those in the low income group and in the older population onto the Internet. Although these initiatives are important to get people included, some fundamental issues still exists. Of particular interest is the use of information communication technology (ICT) to access the Internet among older people.

Although the Office of National Statistics (ONS) in 2010 reports that the number of Internet users in the older market is the fastest growing, it is also the smallest sector. Current statistics shows that home Internet access drops as you move up the age group of the older market, from 69% among the 55-64 years old group to 51% for 65-74 years old group and down to 23% in the above 75 years old group (Ofcom 2010). This tapering of adoption statistics in technology as one moves up the age group is not a new phenomena. Studies done in the past decade for example Down (2002) and Charness et al (2006) have shown a trend of declining new technology usage with age. The main reason cited for not using new ICT products was complexity, particularly the interface, which affected the ease of use. Difficult to set or operate are reported as the main cause for lost of interest in ICT products (Microsoft Survey 2003) (Philips Index 2004). One reason why older people have difficulties with new ICT is because of generation effects due to people belonging to different technology generations.

2. Technology Generations, Formative Experience and Cognitive Changes

People acquire values, norms, attitudes, behaviour, and skills during their formative period, estimated to be between 10 and 30 years old (Rubin, Rahhala and Poon 1998) (Lim 2010). These will usually stay with an individual for a long time and influence future behaviour although they might be changed or reinforced later in life by societal change (Becker 2000). The importance of formative experience with technology therefore has a great impact on the way a user handles present day technology. According to Weymann and Sackman (1993), people who used or experienced certain technologies during their formative period may also exhibit similar usage behaviour in later years. Weymann and Sackman recognised this grouping of people as a 'technology generation' and the authors proposed that different technology generations behave differently with technology, displaying a 'generation effect' due to the way they learnt to interact with and use technology during their formative period. The generation effect can thus be defined as the difference between behaviour and attitudes towards technology shown by different birth cohorts because of the effects and experience of technological changes that occurred in their formative life (Lim 2010). In his paper, Lim (2010) classified different technological eras into (i) the 'mechanical' (M), (ii) the 'electro-mechanical' (EM), and (iii) the 'digital-software' (DS) eras. People who were born before 1930 belonged to the mechanical generation, while those born before 1959 were from the electro-mechanical generation. For those who were born after 1960s, they were called the digital-software generation.

Cognitive changes have a role to play in the concept of technology generations and generation effect. If a person was born in 1945 and during their formative age (which is in the EM era) used and operated products, declarative (semantic[1] and episodic[2]) as well as non-declarative (procedural[3]) knowledge would be acquired and mental models of the devices or system would be formed. Skill, rule and knowledge based behaviour would also be gained (Rasmussen, J. 1983). As a person age, episodic and procedural knowledge declines unless they are meaningful, well learned and practiced by the individual. However, semantic memory that is the acquired knowledge of concepts such as facts, rules and norms would remain stable or slightly decline (Howard and Howard 1997) (Syken *et al*. 2006). As we grow older, the ability to reject learned concepts from the past and replacing them with new ones also becomes more difficult (Wilkies 1988, Hawthorn 2000). Although older people are able to learn new tasks, difficulties in forming an automated response means that it learning new tasks can be difficult as these becomes attention-demanding thus contributing to cognitive load. (Carmichael 1999). At the same time, technology is developing and the era moved from EM to DS. When faced with a new product (DS era) that is unfamiliar, individuals would resort to mental models they had of EM products, which is not useful in the context of the new technology.

In an ONS (2010a) findings report on the types of technology that people from different age groups will missed most, it was found that people aged 65 and over were more likely to miss 'older' technologies such as television, listening to the radio or reading newspapers and magazines then 'newer' technologies such as mobile phones and the

1 Semantic memory involves holding information about the meaning of the things that are around us
2 Episodic memory have to do with remembering specific events
3 Procedural memory is concerned with how tasks are accomplished

Internet. This might not be surprising considering those surveyed who were aged 65 and over belonged to the EM era during their formative age (between the year 1955 – 1975, taking 2010 as the reference year) where the radio and television sets were dominant in their formative life while mobiles phones and the Internet existed only in labs and not in the mass consumer market yet.

It can be generalized that each generation develops a familiarity with the technologies of their own era, and at a particular stage of their lives, and that this familiarity can tend to become both a preferred and enduring basis for choosing technology and way of interacting with products throughout their lives. In the C20th, for example, products have utilized mechanical, electro-mechanical, electronic, and increasingly - into the C21st - software technologies, each of which brings its own set of interfaces, modes of interaction, protocols and degrees of acceptability with users of different generations. Designers and engineers need to be aware of the generation-related effect when designing new ICT products. This effect is due to cognitive changes (as one ages) and the lack of knowledge, experience and skills in handling interfaces that appear after one's formative years. As such an investigation by researchers or designers of mechanical or EM style concepts and their quality of use could give older users whose formative years were in the mechanical or EM era a sense of familiarity and thus enable them to use ICT products effectively and reduce their learning curve.

3. Methodology

A research study was conducted where 12 older and younger participants were interviewed in their homes to investigate i) What they feel are the differences and similarities, in terms of interface, function and usability between past and present ICT product that they

have owned or used? ii) How have they felt about those changes in ICT products? and finally iii) How they have adapted to those changes? Six of the younger participants (aged below 45) belonged to the DS era while the other six participants belonged to the EM era (aged above 56). A semi-structured interview method was used in the study and it was supplemented with a timeline visual highlighting the different eras (Figure 1) and visual prompt cards illustrating products from each decade (Figure 2) to stimulate further discussion.

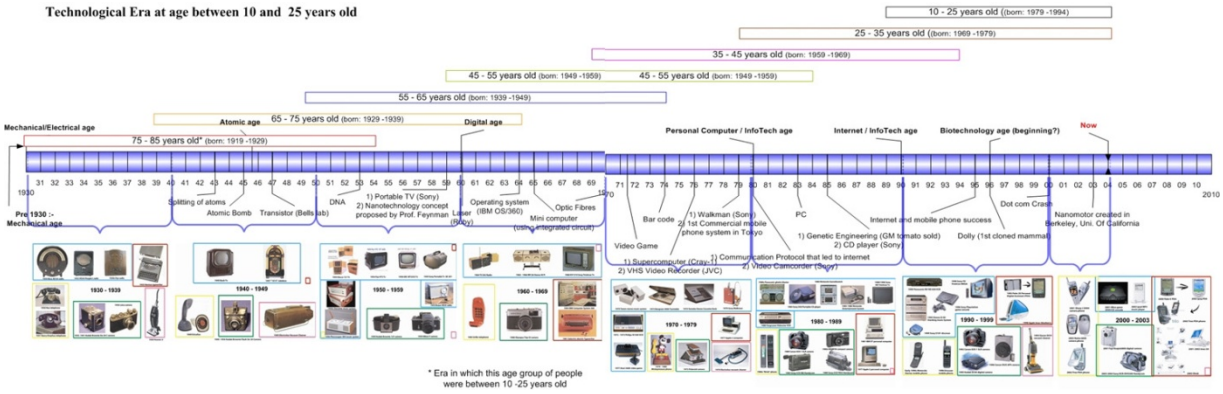


Figure 1. Technology Timeline Chart

Each interview began with the researcher showing a list of generic ICT products drawn from the Office for National Statistic's (2004) General Household Survey and Goodman *et al.* (2003). The participants were asked to recall, if possible, the models of the products they owned or used. This is to allow for the identification of the product in question by the researcher and the participant, avoiding confusion if they own or use several models. This is used in conjunction with the timeline visual and visual prompt cards to help stimulate memory and facilitate discussion among older participants who might have used some of the illustrated products or similar ones from past eras.

All the interviews were recorded, transcribed and anonymised. A thematic analysis was conducted on the transcripts where the data was coded and grouped into seven themes. Seven themes structure the following account: *interaction style differences; interface familiarity; reliability and sustainability; learning, support and adopting new technology; quality of use; social – product interaction change; and attitude towards technology.*

Figure 2: Visual Prompt Cards

4. Findings

4.1 Interaction Style Difference

The participants were asked how they felt about the product interface that they had used in the past and in the present have changed in terms of interface and many of the participants mentioned most present products are complicated and confusing because they are laden with unnecessary features and functions. Using descriptive analysis, the EM generation made more statements (10 statements)

concerning difficulties caused by added functionality and features than the DS generation (7 statements).

"LR: They've become more complex because we got so many more different functions and that I find really frustrating because I think, how many people use, for instance the washing machine. The washing machine has something like sixteen different wash cycles. I maybe use, I use one most of the time and very occasionally I will use a second function. I'd never used all these things that are on there…there are other things where there is just too many options and you don't need all these options"

Participants also brought up the convergence of technology in products. The reaction among the participants regarding the convergence of technology is mixed. Those who welcome it say that it is convenient to have everything in one device, eliminating complicated hardware interface between separate devices as well as allowing you to be carry one instead of several devices.

"PS: ...I think if we can have everything into one from a phone to a MP3 player, to camera, to voice recorder, yah, into one. I think that will be good… That makes life simpler without so many gadgets to carry."

Participants who don't welcome the convergence of devices gave reasons of personal preference as well as in the case of a mobile phone; battery efficiency as having colour screens and other features drain battery life quickly. More importantly they highlighted the associated complexity of more functions that comes with the convergence of technology and conversely the fewer functions a

product has, the more straightforward it is to use as indicated by participant GE and BD.

"GE: …think there are so few functions that its fairly straightforward to use [mobile phone]. A wee bit I think some of the modern ones are just too complicated to use but yes, basic store numbers, dial and that's about it…"
"BD: Umm…it wasn't really easy to use. It was a bit more difficult because it was one of these machines that have multi-function buttons, you know. And one button serves three or four different purposes and you had to kind of press it in conjunction with other ones to get it to do what you want it to do. So err…got a bit confused"

Miniaturisation was also cited as a difference between past and present ICT products and this is evident in ICT products around us. Miniaturisation results in small controls like buttons and dials as well small icons on displays being used and it causes some usability problems among older participants.

"JG: Possible miniaturisation of everything which unfortunately the older you are, the smaller something is, if I have been using something miniature when I was sixteen I would have been fine but the way things have worked out, the older I've got, the smaller things have got and that doesn't, that's not so easy." The issue of small buttons and displays not only affects the older population but the younger ones as well.
"PS: …these buttons are not very friendly in a way…all these buttons are crammed up together. You can't really get the right and left button correctly…".

Both EM and DS generation made about the same number of statements (13 and 12 statements respectively) concerning difficulties caused by the miniaturization of input and output devices such as buttons and displays.

Another difference between past and present ICT products that was brought up is the use of a menu interacting style in present day devices. Products during the mechanical and in some cases the electro-mechanical era have a straightforward interaction structure that relates directly controls to the functionalities of the product. On the other hand, products from the software-digital era employs the menu interaction style adopted from the computer, using navigation and selection procedures that replace the one to one relationship between control and functionality.

"GB: …they (devices) *are all difficult with the invention of the chip…instead of seeing, watching mechanical components running, you can't do that with the industrious chip. It's anyone's guess work. It used to be you have knob that did this and a knob that did that, a slider that did that. Now you choose a button and then have to choose a sub menu and choose a sub menu and then a sub, sub menu…it goes through a host of menus."*

LA, a younger participant remarked she used to have a hi-tech and expensive microwave, which has various button and functions. She got so fed up that she threw it away. She then got a cheaper model, which only has got a turn dial. She just had to turn the dial (to set the power and cooking duration) instead of fiddling with the buttons. This made her life so much easier, she remarked.

An analysis on the number of statements concerning difficulties with the interaction structure of present day ICT products showed that the EM generation made more statements (19 statements) about difficulties with menu interaction style than the DS generation (12 statements).

The simplicity or difficulty in which a task or activity is carried out depends on its structure (Norman 1999). The three structures identified were, 1) wide and deep 2) shallow and 3) narrow. Mechanical or electro-mechanical products would follow the shallow interaction structure, where information or functionality is organised in breadth while software-digital products would follow the narrow structure where it is organised hierarchically. The former is termed single-layer and latter, multi layered or menu based interaction. In Czaja (1996), menu-based interactions were recommended as beneficial for older users because they reduce the working memory demands placed on users. The reason was that menus allow the recognition of options, minimising the need for recall. A multi-layer interface however lacks transparency, obscuring information on other available functionality and the functions of each control, causing an increase in cognition load whereby users have difficulty locating the menu items and getting lost in the levels The use of menus although allows different functions in an ICT product to be accessed unfortunately contributes to the complexity of a device as evidenced through the interviews. In our interviews, a one-layer interface, similar to interfaces found in mechanical and electro-mechanical products, where one button corresponds directly with a function is reported to be easier to operate as they are not so demanding cognitively.

4.2 Interface Familiarity

Participants with positive experience of an interface tend to view them favourably and would be likely to prefer, if possible, the same or near similar interfaces on their new products.

"AC: The Art School [employer] bought a couple of Exxon machines in the 1980s. I read the handbook several nights running. Upon retiring in 1989, I bought myself an Apple Mac…in January 1999 I bought my present computer from Gateway…I would like the set-up to be pretty like the Apple Mac, you know." Another older participant BD remarked, *"…I haven't use that [photo enlarger] for a while but again that was, it was all second nature. That was simply because I did it so, I have been dealing with it. How you use things, you know, it's like driving. You use a car every day, it become very intuitive in every different control. The advantage is that we can learn."*

One of the reasons that people opt for familiar interfaces is that through repeated usage of the same interface, skill proficiency increases and that knowledge and experience is retained in long term memory and when faced with a similar interface they do not have to learn how to operate devices all over again.

"PS: I am a loyal fan of Nokia because it so user friendly and I refuse to buy other…because I started off with Nokia…I'm very lazy to relearn how to use certain functions, if not i…actually don't have to read the manual at all, I don't have to waste my time sitting down going through the whole process learning something, like a new manual and new functions. So that why I bought that phone.

CL: Your old mobile phone was also a Nokia so the function is about the same?

PS: Yeah. The functions are all the same."

When using familiar interfaces the confidence that the device would perform predictably also plays a crucial part. *"LR: I did avoid things like…say the washing machine. I didn't want to have a computerised washing machine, I wanted to have, still a manual dial and things like that because I didn't feel confident with it going wrong.*

CL: SO THE PREVIOUS ONE WAS JUST…
LR: The previous one was just a manual dial, you turn the dial round where you wanted it and its, you press it and it started. Now this one still has a dial that turns round but I was at a friend's house where you just press buttons and you watch for the programme coming up and things and I didn't like that, I like to feel physically that I could turn, you know, that kind of thing...so when I…you know, some new technology I'm very happy and I embrace it one hundred percent but there are other things that I just don't trust, I don't feel confident with."

Sometimes when there are some dissimilarity in the new interface between the previous and new model, past experience, trust and confidence from using near similar interfaces allows the user to adapt accordingly. *"LR: I think because I felt really confident with using a mobile, this (cordless phone) wasn't difficult because it is very similar to using it and then you program in the names in a very similar way. There are a few differences but generally it is very similar, you have, you know, you're up and down buttons in sort of places and things so it is not very difficult to use really."* However in some cases when the dissonance is too great, an unfamiliar interface (in this case an interaction technique) can cause issues and discomfort among its users. For example, older participants interviewed were used to

telephones having a mouthpiece, not having an on-off button and the idea of privacy when speaking on a telephone (i.e. public telephone boxes) which is an antithesis to the mobile phone.

"GB: I still don't feel at home with the, with the err mobile phones because there is nothing you can speak into. You know, I mean, I err…telephone, normal telephone you have something to speak into, something to listen to. But with these tiny little mobile phones, there is nothing to speak into. You're speaking to the people round about, hoping that this is picking it up.
"JG: …I don't like speaking on it (mobile phone), I feel uncomfortable speaking on it in a funny way."
"GB: When we been on a holiday with the family and they have a mobile phone, we take them with us and once or twice if I remember to switch it on… [Laughs]"

In this study all of the participants except one use computers and all of them own mobile phones and other various ICT products. Their proficiency and usage level varies but generally, four out of six older participants (above 56 years old) found present day ICT product interface a challenge to use, they have adapted to these technologies though taking a much longer time.

"GB: But, eh, that was a problem. Till this day, eh, if I get down to my grandchildren and I do stuff on the computer, one of them or rather all, Oh! Granddad you don't need to do that.
CL: [LAUGHS]
GB: Cause they have been brought up in the computer age, they are, they are very fluent in the computer. I'm not familiar but what I learn to do, I can do quite well."

Technology generation states that people who experience the same types of consumer products during their formative period in some respects display similar technology usage years later. The interviews with participants LR, JG and GB reveal some evidences of behavioural differences or generation effect when using certain technologies, examples being fearful of using computerised washing machines and preferring those with manual dials (electro-mechanical interface) as they instil confidence and trust, feeling uncomfortable and agitated when using a digital mobile phone because of difference in the way that they are used (interaction techniques) as compared to analogue telephones. This is because the interface of the mobile phone is very different from normal landline telephones. For the washing machines, the range of controls available are huge from solely dials to push button computerised ones. Contrary, the transition from SLR cameras to digital cameras didn't pose much of a problem for the older participants except the complaining of the use of menus. This could be attributed to the fact that the interface transferred from an SLR camera to a digital camera didn't change much. For the younger participants who are familiar with software style interface, such behaviour wasn't apparent in the interviews as they reveal they have little or no problems in adapting or using present day ICT product interface. As such, the DS generation reported fewer statements (9 statements) concerning difficulties due to lack of experience/familiarity than the EM generation (15 statements).

4.3 Reliability and Sustainability

Using the manual camera as an example, participant GB and GE attributed predictability, reliability and simplicity in usage to mechanical products. The issue of simplicity is attributed to mechanical products having a straightforward interaction style; one button corresponding to a single function.

"GB: …Prior to that (computer age), things were mechanical and work predictably…."
"GE: Its (Manual camera) fairly simple and straightforward and you just focus and set the shuttle speed and click. Because it's mechanical there is not much that can go wrong with it."

Participants find that present day ICT products do not last as long as past ICT products.

"AF: ...One thing is a lot of them don't last the way they lasted. I told you my father had a radiogram and that lasted for years and years, you know. It wasn't abused but it lasted a lot of years. Where a lot of stuff isn't it? Well, I had a black and white portable television. I got them when my daughter was 7 year old, 6 year old, err, it just broke last year and she is 26. It was a Sharp black and white…"

One reason they felt that things don't last as long is because of the current consumer culture where products are endlessly being replaced with newer versions and being disposed of needlessly. Older participants felt strongly against this obsolescence.

"JG: Two things occur to me as well, the other thing, I feel that, I get really irritated with the fact that models are superseded so quickly from the point of view of waste. You know, having actually to take out a radio which is no longer needed and throw it out or, you know, that goes against the grain. I feel as if something should last. I suppose if there were more consideration of how the object will be reprocessed, if there was something build in it, you knew that was sound, just the idea having to take something really complicated and throw it away, I don't like that."

"GB: And there used to be a time, when you can a thing repaired. You don't get to do this simply because it cost more to refill a colour cartridge printer than just to buy a new colour printer…. get a mechanic to come and look at (scanner)…just to check it out. That's right, he looked at it, very good, that worked and so on. He said, mind you it hasn't been working and then he didn't look at it…[laughs] because it's costing me £20 an hour for me to look at it. You can buy a new scanner for £50 [laughs]."

MG: But for the new phone, the reason why have naggings of the replaced components because I know the battery isn't holding its charge. If you got to buy a battery for the phone, it cost as much as the phone! You get a new phone probably for nothing. Well, you have to sign up again for a year, basically we are not paying anything but if you go and buy a new battery, and it cost 50 pounds, which is silly. There is nothing wrong with the phone."

4.4 Learning, Support and Adopting New Technology

The subject of learning, support and adoption came up during the interviews as well. Participants' motivation and determination to learn and use a new technology was greatly influenced by the perceived usefulness of a new technology to satisfy their needs, be it arising from leisure or from their occupation.

"LR: I'm very confident with my mobile phone because I want to use and I am motivated to want to use it and I quickly pick up the things it can do and I use all the things it can do but I don't use the internet on it but I use other things on it."

"GB: I don't know, the…getting the computer in about 1990 was probably a critical point because that led you into a new age all together. Eh, right here [pointing at chart]. Prior to that, things were mechanical and work predictably. From that point on, trying to learn

use the computer, without having the time to get any lessons in the computer, I have to spend a bit of time telephoning help lines, you know, and till this day, eh, I never had a lesson in computer. I do quite complex things, eh, graphically on the computer. Eh, and push the boundaries, in like of excel, which produces graphs."
"CL: [LAUGHS] SO WHAT MOTIVATED YOU TO BUY THE COMPUTER IN THE 1990s?
GB: Oh, when I started PhD. Prior to that, I produce graphs manually. Eh, that's a bigger problem than you think. I do things based on average and mean sentence squares….which was very time consuming and not very efficient. A computer would solve this. It was really Dr David Mealand at the New College, University of Edinburgh that pushed me to get a computer."
"PS: [Laughs] Peer influence, yes it's there I cannot deny that. A little influence on that part…everything started off with someone else has it and then you want it…"

Peer influence and support is also a factor the adoption of a new technology as illustrated in the above quote by participant GB and participant PS.

"MG: A lot of our, you know, contemporaries are quite scared of computers; they may have a computer and have e-mail. You ask them if they, we send them something and they say we never look at our e-mail. (JG: That's right) It is infuriating. We were determined that we were going to use it and…
JG: You were determined! [Laughs] We do, we do.
MG: It is in fact we didn't have a computer until 1996 and started this sort of sideline business of flats and things; we need something for a database and for word processing initially and gradually we've learned how to do more things and now, we use it to shop, buying, get

information and buy tickets but a lot of our friends don't, I can understand why."

Participant MG mentioned the issue of fear in the above quotation. A study by Marquie (2002 cited by Eisma *et al.* 2004) reported that older people, who assume that they have no use for the computer, are more unwillingly to learn and experience apprehension when they are asked to use it. Those who are willing to learn and use new technologies speak of using simple strategies, such as writing personal instructions and post-it notes to help them.

"AC: I have all the little instruction just behind me there [behind the mobile phone]".
"LR: …but I am still at that stage where I have post-it notes with a list of things to do to remind me of how to scan it to save it to alter it. You know, It's like everything, it's just the confidence, the more I do it, the better I get, the more confident I become but like almost everyone's life's, there is not actually time for me to practice so I just keep going doing all the different things and think I will get round using the computer, I will get round to being more confident in my camera…."

From the above quotations, the decision to adopt a new technology can be based on the innovation-decision model prescribed by Roger (1995). The model (refer to Figure 3) describes a 5 stages process of knowledge, persuasion, decision, implementation and confirmation through which an individual passes through each stage to reach full adoption. Participants LR, AC, JG, MG and GB went through this process. Using the example of participant GB who is from the EM generation, he was doing his PhD and having to produce graphs manually was very time consuming and inefficient. He had a problem and a need, which sets up the prior conditions.

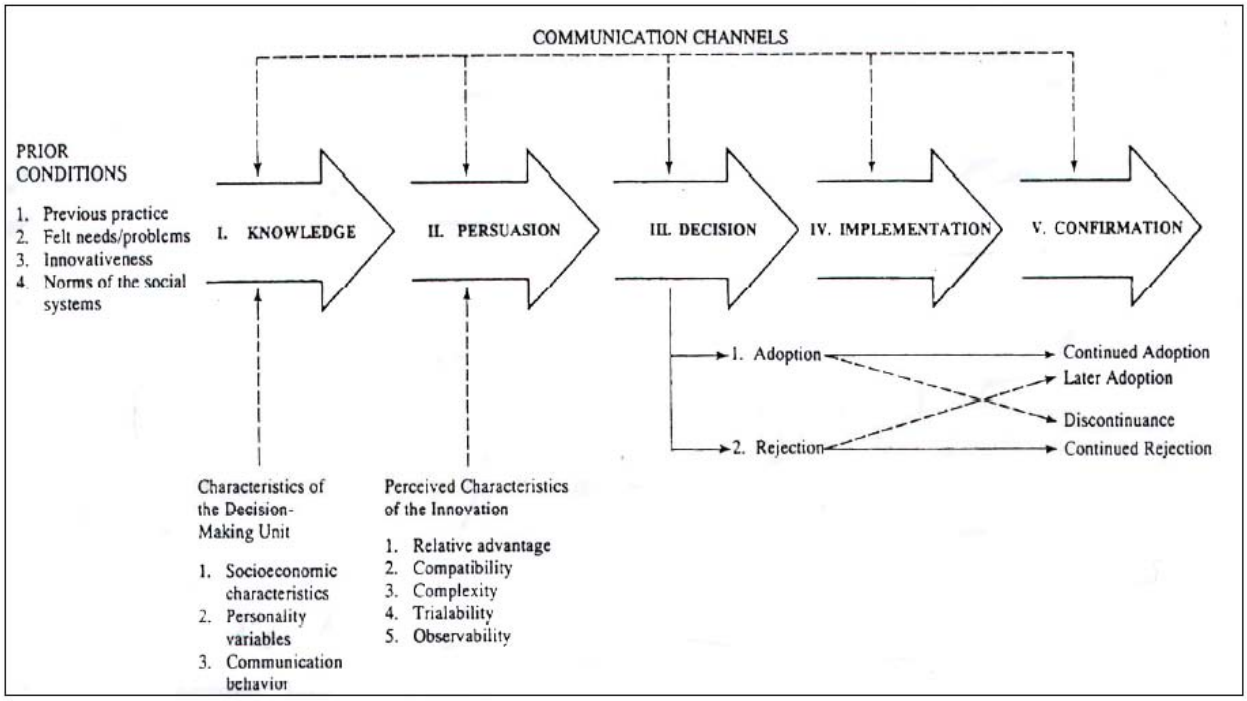


Figure 3 Innovation-Decision model (Source: from ROGERS, E.M., 1995. *Diffusion of innovations*. 4th Ed. New York: The Free Press, p.163.)

When he approached his colleague for help, he recommended that a computer could solve his problem and satisfy his need. Participant GB however had no experience or knowledge whatsoever in using a computer and he was obviously reluctant to adopt the computer until he was 'pushed' to get a computer. Roger (1995) identified three types of knowledge, 1) Awareness 2) How-to and 3) Principle Knowledge. From the interview, participant GB was made aware of the existence of computer technology that could help him and that motivated him to seek "How-to" (information necessary to use a technology properly) and "Principle Knowledge" (information dealing with the functioning principles of how the technology works). Previous experience or knowledge on how the past technology works may also be used to generalise towards the use of new technology but for participant GB,

he did not have such experience therefore resorting to self study and call centres to learn how to use a computer.

“How-to” and “Principle Knowledge” may also occur in the persuasion and decision stage according to Roger. From the interviews, evidence of continued learning suggest that the acquisition of both these types of knowledge goes beyond the decision stage and into the implementation (where an individual puts the technology to use) and confirmation (seeking reinforcement or overturn an earlier decision to adopt or reject a technology if exposed to conflicting messages about the technology) stages as well where the user decides whether to continue or discontinue adoption of the technology. This knowledge is important as it affects the next level, which is the persuasion stage where favourable or unfavourable attitude is formed towards the technology. Of the five characteristics (relative advantage, compatibility, complexity, trialability and observability) of innovations that determines an individual’s attitude, complexity is of interest to this study because if a technology or ICT product is perceived as difficult to understand and use, then it will be adopted slowly or not adopted at all. This is consistent with the interview results from interaction style and interface familiarity sections.

Support from friends, family, experts or subordinates also helped the participants with the learning process and in continuing to adopt and use the technology. This was particularly more common for those in the EM generation than the DS generation. Findings from the Scotland’s Futures Forum (2006) confirm this finding that older people are more likely to ask family and friends for assistance in familiarisation of new technology.

"AC: I'm really good at delegating; I can just look stupid and go into the Link (Mobile phone retail shop) and say err… you got a naff but [laughs] I haven't activated this card (top up card). She said [change to a low voice tone] all you got to do is listen to the instructions. [Change back voice] Oh yes, would you like to do it? So, she did it so no doubt my card is activated now. And I haven't put, just forgot to put any more money into it so perhaps some money in…. should find out."
"JG: We have been fortunate also that we have neighbours and friend who helped us when we have our problems.
MG: Which we do.
JG: We have people who are sort of computer literate."

Participant LA who is from the DS generation confessed that she only knew how to take pictures with the digital camera but had no idea how to use the other functions like changing resolutions or downloading the photos to her computer. To do that, she gets her secretary to do it.

GB said that when he uses the computer and when his grandchildren is around, they would often tell him that there is an easier and faster way to accomplish what he is doing and he tries to learn from them as much as he could.
"LR: I think it (mobile phone) was fairly intuitive and I think I have got the advantage in that, I got three teenage daughters and so, if there was any problems at any point I would say, oh, hang on a minute, how can I change whatever, whatever and one of them would say, oh, you just have to go to applications and you would find whatever and you I did that and it was fine so…I adapted to this one without any problem."

One of the modes for learning besides through friends and family is through instruction manuals, however Allwood and Kalén (1997) reported that there is widespread dissatisfaction among users regarding the poor usability of the manuals. From the interviews, there are more statements of complains among the older participants that documentations or user manuals nowadays are too complicated. Common complains are that manuals are sometimes are quite hard to follow and when they show graphical steps, it is either that they have difficulties in deciphering what the graphics is about or sometimes the graphics do not correspond to the instructions. This could be one reason why older participants are more likely to ask for assistance in familiarisation of new technology.

4.5 Quality of use

Participants interviewed who were familiar with older mechanical devices found the controls (i.e. interaction techniques) more pleasurable to use when compared to their modern equivalent. . This is especially true for older participants from the EM generation. The sense of pleasure derives from the strong engagements of the senses through appropriate feedback in mechanical products. The ICT products mentioned here were the telephone, camera and radio.

"AC: I must say the controls on the SLR are very satisfying. They are very chunky and mechanical and err…it's like an older technology, it's practically Victorian, it's sort of , and you can really feel you're… pressing a switch and with a, of course this (digital camera), you just, a little touch and err…you photograph…quite, quite different."

"*JG: I like the rotary…I like dialing, I did actually like dialing. I like the sort of, you know, the positive sense that you could see if you are dialing something…"*

"GE: Yeah, that was nice. Yeah. There was a noise as it returned… There is a mechanical "clicking."
"GB: Yes, yes we have the rotary ones and before that we have one that [gestures; one fist over the mouth and the other over the ear]. It was good, it was much better fun than any of the modern ones because you can take the receiver and put it to the microphone and get feedback and it will go 'Whoor! Whoor! Whoor! Whoor!' [Laughs]"
"BD: its (radio) not pushbutton tuning, it's a dial button, it's a beautifully…it's a big heavy wheel that turns beautifully, it's really nice to turn …"

Conversely, younger participants from the Digital-Software generation found that Digital ICT products are more pleasurable to use

"LR: …It's (Digital MP3 player) a nice wee silver thing. It's nice and small and neat. I do like small, neat things. It's small and neat…"
"JG: emotional satisfaction… I think it's (digital camera) well designed and I think I can use it quite well…It does promote interaction, I mean the results that derive from that, being able to send images straight to family or to friends or something, it enhances our social…"

The participants also spoke of the need to design the interface appropriately. For example participant BD recounted that although buttons in modern phones were easier to manipulate compared to rotary dial, especially for people who have weak hands (mentioned by participant AF) or suffering from arthritis but if not well designed, it is liable to create feelings of frustration.
"BD: Well, I'm old enough to go back to the big heavy phones that you dialled. And err…they were very functional pieces of machinery. I can remember one we had at home that had a handset at the top, a big heavy handset and the dial that, you know, you actually put your

finger in and turn, had a drawer at the bottom that you pull out with a little pad that flipped up with all your phone numbers on. That was actually very functional in its day because very seldom will you dial…a phone number with more than six digits so the dialing like a…you know, it wasn't too ominous but now especially if you are phoning a mobile phone, it's far easier to press the buttons so…however, my mother-in-law is 81. She's got a press button digital telephone. It's badly designed and every time she puts it up to her face, she presses the button that cuts it out. "

"AF: I miss the old dial ones, yeah, the round ones, I got one of them for a long time. I think I still got one actually. The only good thing with the press button one, they are good for people who are not very good using their hands. It's easier for them to press. Press. [Articulating with hands] You know, rather than going around that way, and sometimes you use to misdial going around that way, you know…"

The use of touch screens (a product of the digital-software era) although is effortless to press suffers a loss in tactile feedback. This resulted in participant DF not being able to physically feel the buttons to operate his touch screen remote control. The quality of use suffers in this respect.

"DF: …if I'm sitting like this, I just turn on that, you know, and I don't look at the remote control (conventional remote control) whatsoever and that LCD thing (touch screen remote control) just meant you have to look at it to just flick. Turns into this device that kind of like, you have to, flicking is really difficult because you have to press the button and do this, you know, it's like really stupid.

CL: IS IT BECAUSE THE WAY IT'S TOUCHSCREEN, YOU CAN'T REALLY FEEL …

DF: Yeah, you can't feel the buttons basically…"

4.6 Social – Product Interaction Changes

The relationship between how the users interact with products within the current social context is important as it affects the formation of experience. The interviews revealed some interesting background on how the television, radio and telephone were used then and now, reflecting social and product interaction changes.

"BD: I can remember our first television when I was a child, had a twelve inch screen, black and white and it was in a cabinet to make it look like a piece of furniture, with 2 doors that close over the screen if you weren't using it and err…the programmes were only on a certain period each day and then it close down. Television closed down at five o'clock and started up again at half past seven to allow people to have their dinner whereas now of course it twenty four hours and err…so I suppose that's a major change, that's not a change in the product itself, but the product itself reflects that kind of change in that…earlier one that I was talking about, was a piece of furniture in our house, that you use it at certain times, like the way you would use a dining table or the way you would use a wardrobe, you know, use it at certain times, whereas now, the televisions are a kind of a…it's not something you would call furniture now."

"CL: SO I GUESS THE INTERFACE OF THE RADIO HASN'T CHANGED MUCH?
BD: No, no. I think what's changed is the social interaction with it. People used to sit round it and listen to it. Now, you listen to the radio while you are doing something else usually. That's why a lot of radios are in the kitchen you know, people listen, and my wife listens to radio when she is working in the kitchen.
CL: IS THERE ANY PARTICULAR REASON WHY…ERR…YOU KNOW, YEARS BACK YOU WOULD SIT DOWN AND LISTEN TO WHATS ON THE

RADIO INSTEAD OF WALKING AROUND? IS IT A LIFESTYLE CHANGE OR IS IT BACK THEN IT WAS JUST THE RADIO?
BD: I think it's probably programme as well, I think there would be far fewer programmes, they broadcast at seven o'clock at night and people were sitting there in the living room or something like that and you probably have to fiddle with them a lot more to get, to keep the signal strong so you probably have to sit closer to it."
"BD: …people spend a lot more time on the telephone, they phone each other much more often than they did thirty years ago where a phone call would be a fairly unique experience, you know. So, you have to be able to use the telephone on the move now or you would have no time for anything else because you would be spending half your day on the telephone whereas forty years ago, if you got two phone calls a day, you were lucky and most of them, those would be about one minute length."

Out of the 12 participants, only one younger participant (AF) did not own any mobile phones because she did not feel the need for it. Of the 11 that owned mobile phones, 7 of them said the mobile phone was not an integral part of their life as they don't use it much and could have live without it. Most from the EM generation kept it because of security reasons or in the event of an emergency. Younger participant DF, PS, LR uses the mobile phones for communicating with friends and family whereas older participant MG uses it mainly for business.

"BD: Well, I'm old enough now to be, maybe come into the category of a grumpy old man. My, I could live without a mobile phone. Sometimes I think that they are an incredible nuisances and an incredible intrusion of our privacy but equally there is no denying that they are incredibly useful at times too in terms of organizing your life, fitting more into the day and in terms of safety as well if you're, Umm,

my wife's out in the car and it breaks down, she's got the mobile phone, she's a lot safer than she is without it so, it's a, plus and minus."

"GB: We got a mobile phone because our children walk around with them strap to their waist and use them all the time and we have no real need for it, for the mobile phone at all. Sometimes we take it with us if we are going for a pretty long ride in the car. Stick the mobile phone into the car because if we have a breakdown we can get help..eh..we haven't had a breakdown."

"CL: SO YOU USE IT VERY OFTEN?

GE: No, for emergencies."

"AC: And I only got this recently and really I haven't investigated all it can do and I probably don't intend to because, because I just wanted it for emergency…But of course just to have it for, if the landline goes off for some reason, and umm… also for security, I mean, I mean I feel in fact very secure here but suppose if somebody did cut the landline, one has the mobile and I suppose it's excellent to have that here."

Participant LA uses her mobile phone (an old Nokia 'brick' phone) only for emergency, She hardly uses it because she is in the office most of the time and she does her correspondence through her office phone and e-mails.

4.7 Attitude towards Technology

The participants' attitude towards technology varies, but the majority has a positive attitude towards it especially in areas that would benefit their life.

"CL: HAS YOUR ATTITUDE TOWARDS TECHNOLGY CHANGED?

LR: It has, I mean, I probably am, I am probably far more welcoming of things now then I could imagine, and I know that just compared to a lot of my peer group, you know, friends who live roundabout and things like that, they possibly would have say a mobile phone but they wouldn't really use it or I would send them a text and they would go, I really don't know how to text you back, you know, I can get that text but I can't text you back so I noticed things like that and things like the internet. They are probably starting to use the internet now but you know, it's taking them a while to actually get to that point but as soon as I realised what the internet could give me and what it could do, I couldn't you know, I was really keen to use it. And things like PowerPoint, I was very keen to learnt to use the PowerPoint and to use that and err… but you know, once I'm aware what technology can do for me, I will go all out to make sure that I feel confident using it."

Participant GB who is the oldest at 76, is not the typical technophobic older person often reported in studies but one who uses a minidisc player, video recorder and computers. *"GB: I don't know, the…getting the computer in about 1990 was probably a critical point because that led you into a new age all together..."* He pointed out that getting and learning a computer while he was doing his PhD opened the door to the digital-software age for him. His receptiveness to new technology is selective subjected to perceived usefulness to his lifestyle. He mentioned during the interview that his background and personality probably makes him more receptive to adopt and adapt to technological change. As a young boy, he used to tinker with cameras and build radios and this trait is still evident in him as he takes his computers apart and upgrades its components.

Participant AC who is above 66 years of age uses the computer, digital camera and owns a mobile phone, which she uses only for emergency.

She was introduced to the computer in her workplace and learned to use it through reading manuals. Participant AC attitude towards technology is generally positive and she mentioned in the interview that she is having fun using her computer (using Paintshop Pro software) and digital camera for her creative work, which is painting.

"AC: Just grateful if it's (technology) coming along. It's great fun.
CL: IN TERMS OF USABILITY, HOW DO FEEL THAT USABLILITY HAVE CHANGED? HAVE THINGS GOTTEN EASIER OR…
AC: Yes, you can just do so much more and err…well, I think everyone crashes a computer from time to time, because things always breakdown sometimes, don't they? But, in fact, you have only just missed a great breakdown. I managed to get it back from err…it started to deny that it knew it had a CD drive and various other troubles and the guy just took the tower away and brought it back again and err…and emphasize that I had to have it back by the 29th. (Before the interview) [Laughs] so it came back on Friday. But err…well I suppose everybody suffers from time to time. And err…I do silly things with it, no doubt. It's been pretty good really. Oh dear, as soon as I say that something terrible is going to go wrong.
CL: [LAUGHS]
AC: Superstitious.
CL: SO BESIDES THE COMPUTERS, WHAT OTHER, WHAT ABOUT THE OTHER PRODUCTS, HOW DO YOU FEEL IN TERMS OF USABILITY?
AC: Well, if something is difficult, I always assume that it's me. Ummm…not been very intelligent at some point, you know, the instructions say press this button, I press it. [Laughs] Fair enough."

Although participants AC and JG (see below quotations) use computers, digital cameras and own mobile phones they feel that they are not technologically competent. Participant AC, JG and LR faulted

themselves for what could be poor design of the interface, which makes it complex and difficult to use.

"JG: we had gas lights and no electricity until I was sixteen. So that's my excuse for being not very technologically…[laughs]"
"JG: I point, focus and clink. And I can change the card if I really have to, I have no pleasure from, sort of going into highly technical things, that gives me no pleasure, in this respect anyway. I'm not particularly interested in that, I suppose I have a guilt feeling about not using it more fully because I recognised that it can do a great deal and I perhaps too lazy or to not interested to take it any further."
The participants also gave their views on why younger people seem to be better with new technology with participant LA saying that younger people have more time on their hands to explore technology while participant LR talks about difference in behaviour towards technology due to their experience and how certain mental models of the way things worked still stayed with them despite changes in technology.

"CL: WHAT DO YOU THINK IS THE, FOR THEM (TEENAGERS), THEY WILL BE MORE CONVERSANT WITH TECHNOLOGY? IS IT BECAUSE THEY USE IT MORE OFTEN OR?
LR: No, they are just confident, they are confident, they don't have, I think the problem with my generation is that we have a fear of breaking it, we have a fear that if we press the wrong thing, everything is going to explode in our faces or something terrible is going to happen whereas they are very confident to just press a button, try this, try that, you know, they are not worried about getting lost in the maze of computing, you know, we all can think, we are going to get so far, we are going to press something and everything is going to fall apart whereas they know they can always backtrack on themselves. I think it's a confidence…

CL: YOU WERE SAYING THAT YOUR GENERATION HAS A FEAR OF BREAKING THINGS. WHERE DO YOU THINK THAT FEAR STEMS FROM? IS IT BECAUSE OF THE WAY YOU USE PRODUCTS, YOUR UP BRINGING OR…

LR: I think it is a combination of things, I think the fear of new technology is this whole thing of, oh! I'm going to crash the whole computing system, you know, that kind of thing or I'm going to do some irreparable damage to this expensive item. If you got something that is very mechanical, the only way you are going to damage it irreparably is by dropping it or by battering it with a big hammer or something like that whereas I think that we feel or people of my generation possible feel that computer and things are more vulnerable to something very small like the wrong combination of pressing buttons or turning something on and off in the wrong place and perhaps when computer was first introduced to us, that was the case, but if you press the wrong thing at the wrong time, something terrible could happen, your system could completely fail whereas now there are so many different things that are set up so that if you do press something, it's going to say to you, you have turn this off incorrectly, please make sure if you shut that down, you would so this, that and the next thing. It tells you know and computers talk to you all the time now whereas at the very beginning when computers were first introduced to us, it didn't and you just felt I don't have enough knowledge to cope with using this."

5. Conclusion

This study has identified several concerns of participants from the EM generation regarding ICT from the DS era. The interviews revealed that the increase in features and functions as well as the use of multi-layered menus in ICT products was the cause of complexity for participants from the EM generation. Because of the proliferation of

features in modern products either through the convergence of technologies (example: camera-phone), lack of user consideration or because of marketing pressures to differentiate from competitors, input devices such as buttons on these products often have many different usages or functions unlike products in the mechanical age where one button corresponded to a single function. The miniaturization of technology and its components caused obvious usability problems (e.g. some buttons are too small for older users). Miniaturisation and digitalisation also allow some products to have their user interface as a separate entity. The remote control is one example. This leads to a certain extent more functions on a single small device.

Present day ICT products often have a computer like display and employs a menu interaction style creating multi-layers using navigation and selection procedures, replacing the direct relationship between the controls and tasks. The EM generation reported that they could interact with products from the mechanical era directly, whereas in digital products one often has to go through a host of menus to get to what one wants. Digital products often have multi-function buttons, creating multi-layers. A multi-layer interface based on a hierarchical structure lacks transparency as it obscures information on other available functionality. Czaja (1996) recommended that menu-based interactions were beneficial for older users because they reduced the working memory demands placed on users as menus allow the recognition of options, minimising the need for recall. However, participants from the EM generation have complained of difficulty locating the menu items and getting lost in the levels. The many layers and lack of transparency in modern interface menu hierarchies (e.g. in mobile phones) can confuse older users, or more specifically those who did not learn this mode of interaction when younger.

Participants from the EM generation felt that products that use more mechanical input devices (i.e. knobs, turning dials etc.) found in mechanical and electro-mechanical products seemed to elicit a more pleasurable response. The participants perceived that mechanical and electromechanical products to be more reliable, predictable and serviceable compared to digital-software products thus inspiring confidence and assurance in them.

The socio-cultural values and context of use of certain products from the EM era have changed in the DS era. The EM generation remarked that although the basic function of the television and telephone remains the same however the mode of use and interaction with products and their social use is now very different from that what they experienced in their younger formative days. It evolved from a communal, immobile and usage scheduled device to one that is about personalisation, convenience and immediacy. This change in contextual use can create a barrier to which older participants might find it difficult to adjust, for example speaking to or using a mobile phone or utilising the technology's potential. All the EM generation participants interviewed had an interest in learning new technologies but it must be beneficial to them and thus they were more selective in what they were willing to learn. In cases where they encounter difficulties or couldn't be bothered with learning a new technology, they would often ask close friends, relatives or product specialist to assist them.

Designers and engineers need to be aware of the generation-related effect when designing new ICT products. This effect is due to cognitive changes (as one ages) and the lack of knowledge, experience and skills in handling interfaces that appear after one's formative years. This is particular relevant when we move beyond graphical user

interface to tangible user interface where advanced input and output devices such as electromagnetic, optical, acoustics and kinaesthetic, 3D or augmented technologies are used. In tangible user interface or tangible interaction, digital information is augmented into the real physical world through everyday objects and environments (Ishii and Ullmer 1997). As such an investigation by researchers or designers of mechanical or EM style concepts and their quality of use could give older users whose formative years were in the mechanical or EM era a sense of familiarity and thus enable them to use ICT products effectively and reduce their learning curve.

6. References

EU Ministerial Declaration (2006) The Riga Declaration. Riga: EU. Available from: http://ec.europa.eu/information_society/events/ict_riga_2006/doc/declaration_riga.pdf [Accessed 24 March 2011]

Office for National Statistics (2010) Statistical Bulletin – internet Access 2010. Available from: www.statistics.gov.uk/pdfdir/iahi0810.pdf [Accessed 26 March 2012]

Ofcom.,2010 Communications Market Report. Available from: http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cmr10/downloads/ [Accessed 26 March 2012]

Down, D., 2002. Family Spending – A report on the 2000-2001 Family Expenditure Survey. The Stationary Office, London, UK.

Charness, N., Czaja, S.J., Fisk, A.D., Hertzog, C., Nair, S.N., Rogers, W.A. and Sharit, J., 2006. Predicting the use of technology: Findings

from the Centre for Research and Education on Ageing and Technology Enhancement (CREATE*). Psychol Ageing*, 21(2), pp.333-352.

Microsoft Survey., 2003. *Accessible technology market research*. [online]. Commission be Microsoft, conducted by Forrester Research Inc. Available from: http://www.microsoft.com [Accessed 24 August 2005]

The Philips Index., 2004, www.usa.philips.com

Rubin, D.C., Rahhl, T.A. and Poon, L.W., 1998. Things learned in early adulthood are remembered best. *Memory and Cognition.* 26(1), pp.3-19.

Becker, H.A., 2000. Discontinuous change and generational contracts. *In*: S. Arber and C.Attiats-Donfut, eds. *The myth of generational conflict*, England: Routledge and Keegan-Paul, pp.114-132.

Weymann, A. and Sackmann, R., 1993. Modernization and the generational structure. Technological innovation and technology-generations in East and West Germany. *In:* H A BECKER AND P L HERMKENS, eds. *Solidarity of generations. Demographics, economics and social change and its consequences.* Amsterdam: Thesis.S., pp. 721-743.

Lim, C.S.C., 2010. Designing inclusive ICT products for older users: taking into account the technology generation effect, Journal of Engineering Design, 21: 2, 189-206,

Rasmussen, J., 1983. Skills, rules and knowledge: Signals, signs and symbols and other distinction in human performance models. IEEE Transactions on systems and cybernetics. SMC-13, p.13

Howard, J.H., Jr. and Howard, D.V., 1997. Learning and memory. *In*: A.D. Fisk and W.A. Rogers, eds. *Handbook of human factors and the older adult*. San Diego, CA: Academic Press, 7-26.

Syken, J., Grandpre,T., Kanold, P.O. and Shatz C.J., 2006. PirB restricts ocular dominance plasticity in visual cortex. *Science Express.* 17 August 2006.

Wilkies, A.L., 1988. Forget that. It was wrong. Editing episodic memory to accommodate for error. *In*: M.M. Gruneberg, P.E. Morris, and R.N. Sykes, eds. *Practical aspects of memory: current research and issues.* London: Academic Press, 496–501.

Hawthorn, D., 2000. Possible implication of ageing for interface designers. *Interacting with computers,* 12, pp.507-528.

Carmichael, A.R., 1999. Style guide for the design of interactive television services for elderly viewers. Winchester, UK: Independent Television Commission.

Office for National Statistics., 2010a. e-Society: Social Trends 41. Available from: www.statistics.gov.uk/articles/social_trends/e-society-2010.pdf [Accessed 2 August 2011]

Office for National Statistics., 2004. *General Household Survey 2003 – 2004*. Essex: UK Data Archive, 5150.

Goodman, J., Syme, A., and Eisma, R., 2003. Age-old QUESTION(naire)s. *In*: *Proceedings for include 2003 conference*, 25–28 March 2003. London: Helen Hamlyn Institute, 7:276–7:285.Norman 1999.

Czaja, S.J, 1996. Ageing and the Acquisition of computer Skills. *In:* W.A. Roger, A.D. Fisk, N.Walker, eds. *Ageing and Skilled Performance.* Mahwah, NJ: Lawrence Erlbaum Associates, pp.201-219.

Eisma, R., Dickson,A., Goodman, J., Syme, A., Tiwari, L. and Newell, A.F., 2004. Early User Involvement in the Development of Information Technology-Related Products for Older People. Universal Access in the Information Society, 3 (2), pp.131-140.

Rogers, E.M., 1995. *Diffusion of innovations*. 4th ed. New York: The Free Press.

Scotland's Future Forum, 2006. *Growing older and wiser together.* Edinburgh: The Scottish Parliament.

Allwood, C.M. and Kalen, T., 1997. Evaluating and improving the usability of a user manual. *Behaviour and Information Technology,* 16(1), pp.43-57.

Ishii, H. and Ullmer, B., 1997. Tangible Bits: Towards Seamless Interfaces between People, Bits, and Atoms. In *Proc. CHI'97*, pp. 234-241.

Cold Work: Tools for designers to extend active living through more effective inclusive design

Professor Jeremy Myerson

Director

Helen Hamlyn Centre for Design

Royal College of Art

Kensington Gore, London SW7 2EU, United Kindgom

e-mail: jeremy.myerson@rca.ac.uk

Jeremy Myerson is Director and Chair of the Helen Hamlyn Centre for Design at the Royal College of Art, London, where he also leads the management board of the InnovationRCA network for business. As an academic, author and activist in design, a key theme of his work is the impact of a people-centred design approach on innovation. He is the author of a number of influential books and is an adviser to design schools in Hong Kong and Korea.

Cold Work: Tools for designers to extend active living through more effective inclusive design

Professor Jeremy Myerson

Helen Hamlyn Centre for Design, Royal College of Art, Kensington Gore, London SW7 2EU, United Kindgom

Abstract

For a decade between 2000 and 2010 the i~design research project, a collaboration between Cambridge Engineering Design Centre and the Helen Hamlyn Centre for Design at the Royal College of Art, raised the profile and uptake of inclusive design in business and practice. This paper describes the specific tools for designers that were produced in the third and final phase of the project – and explains how these were tested via a short hypothetical brief to a London design firm to design a new way to de-ice a car windscreen in winter.

1. Introduction

Against the background of rapid population ageing, the study and practice of inclusive design in the UK has grown considerably since 2000. This rise in activity and profile has been catalysed in part by the ten year i~design programme of research (2000-2010) funded by the EPSRC (Engineering and Physical Sciences Research Council) and led by Cambridge University's Engineering Design Centre (EDC) in partnership with the Helen Hamlyn Centre for Design at the RCA.

The first phase of the i~design programme (2000-2004) concentrated on building an academic knowledge base in inclusive design. Undertaken in collaboration with Design for Ability at Central St Martins College of Art and Design and the Design Council, this phase resulted in an number of influential outputs that laid out the ground, including a major book, *Inclusive design: design for the whole population*, edited by John Clarkson, Roger Coleman, Simeon Keates and Cherie Lebbon (Springer 2003).

The second phase of i~design (2004-2007) set out to understand commercial needs and engage the business community in inclusive

design. This phase was undertaken in collaboration with the Centre for Usable Home Technology at the University of York and Applied Computing at the University of Dundee. It produced a new British Standard BS7000-6 2005 - a guide to managing inclusive design, followed by a series of workshops with UK companies and a substantial body of case studies of inclusive design in action in business. A web resource for industry in the form of an inclusive design toolkit went live in summer 2007, supported by BT.

The third phase of the programme (2007-2010) sought to build on previous work by focusing on designers and their interactions with people. Cambridge University's Well-being Institute and the Loughborough Design School at Loughborough University joined the research consortium for the third phase. The aim was to make the practice of inclusive design more effective by giving designers more accurate, relevant and up-to-date data on capability in the population, combined with a robust model of human-product interaction with reference to environmental and social contexts of use. A key part phase three was to conduct a 400-person pilot to test the requirements for a new survey of national capability.

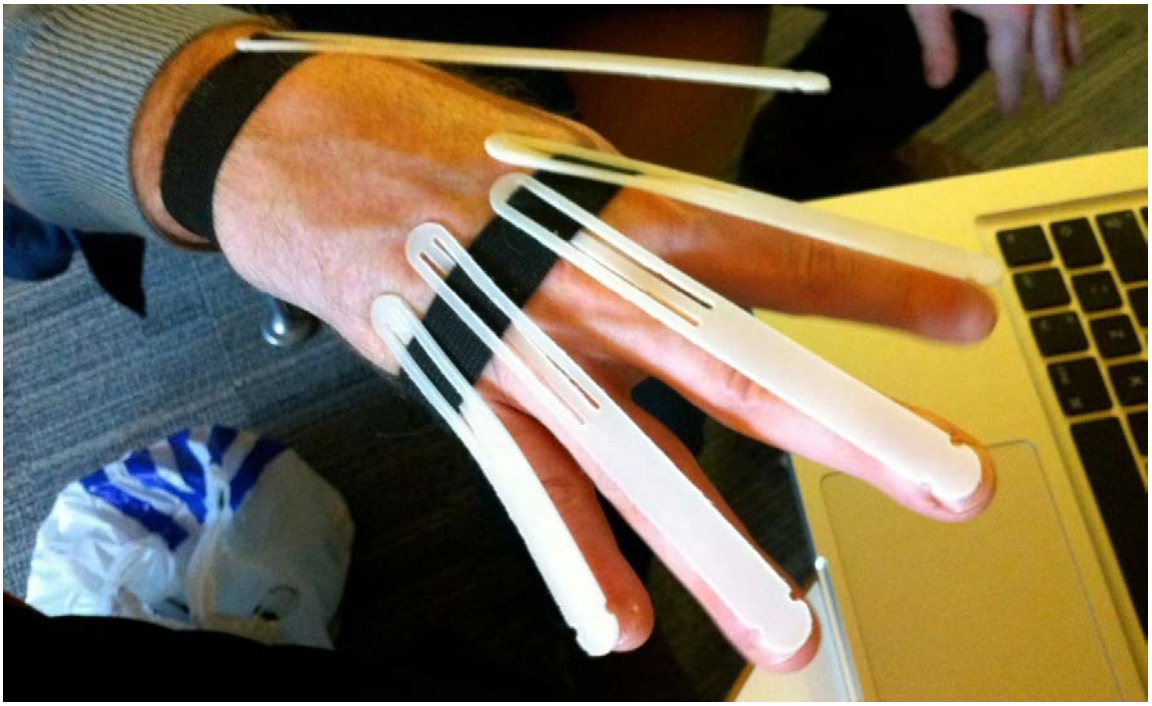
By providing designers with improved data in a form that would be most useful and by creating advanced tools for calculating levels of inclusion, the i~design team wanted to support the practical development of new products and services that would give older people greater independence and bring disabled people into mainstream life and employment. Building on earlier phases of i~design which defined inclusive design and made the business case for its practice, this final phase – oriented towards the work of designers – was regarded by the research team as critical to the whole i~design programme.

2. New Tools for Designers

Cambridge Engineering Design Centre produced a range of tools to help designers put inclusive design into practice, hosted on the website www.inclusivedesign.toolkit.com. These include a Demand Assessment Grid, which assesses the vision, hearing, thinking, mobility and dexterity demands associated with each of the steps required when interacting with a product; Impairment Simulation Tools such as gloves and glasses that enable designers to experience the effects of visual and physical impairment for themselves; and an Exclusion Calculator that quantifies the proportion of the UK population that would be unable to use a product.

A particular focus of i~design 3 was on evaluating products and services through Exclusion Audits. These were developed through a series of experiments and examine the demands a product places on users' capabilities – for example, a mobile telephone may have small buttons requiring a certain level of dexterity to operate. The Exclusion Calculator guides designers through the process of conducting an Exclusion Audit and estimates the percentage of the UK population who would be unable to use the product due to its demands. Work on

the Exclusion Calculator involved developing and testing algorithms for the underlying calculations, and reanalysing the population data so that it is more suitable for design purposes. The Exclusion Calculator is, however, limited by the data that is currently available, so the i~design team developed a pilot survey to produce a more suitable database.



A team from Loughborough Design School at Loughborough University investigated the extent to which everyday contexts of use impact on the way people use products. Context of use refers to the circumstances in which a product interaction takes place and can include factors such as lighting levels, temperature, weather conditions, vibration, noise, assistance from other people, a person's mood, and so on. Early in the project, focus groups and observations with older people helped to identify situations where context has the biggest impact upon product use. The team explored people's feelings and motivations, the nature of their everyday tasks and both the physical and social environments in which they interacted with

products. These terms formed the basis of a Context Framework, which illustrates the multi-faceted impact of context upon user capabilities and product demands.

Two experiments were conducted with older people aged 65 and over to determine what effect the physical environment has on two key product interaction capabilities – vision and dexterity. For vision, four everyday lighting levels were investigated (daylight, overcast, in-house lighting and street lighting) with older users reading different letter size and contrast combinations. Findings from this experiment demonstrated the importance of considering ambient illumination when designing everyday products. For dexterity, neutral (19°C-24°C) and everyday cold temperatures (5°C) were investigated. Findings from the dexterity study indicated that grip strength (power and pinch grip) is not affected by 5°C cold temperatures. However, fine finger dexterity is significantly reduced when a person is exposed to this average winter temperature.

The experimental data was developed into a design tool called the Context Calculator and iteratively tested with designers to ensure its usefulness and usability. This tool provides data on older adults' capabilities in a range of environmental conditions related to everyday lighting conditions and cold winter temperatures. The RCA research team in the Helen Hamlyn Centre for Design worked closely with colleagues at Cambridge and Loughborough to turn their scientific findings into practical resources for designers. A key objective was to bring hard capability data alive for the design profession in an empathic and meaningful way. This research was consolidated in an open-access web-based resource (www.designingwithpeople.org) that explores the current shift from designing for people to designing with

people, aims to offer a wealth of practical information on inclusive design practice.

The website has four main sections. A People section presents 10 individuals drawn from the Helen Hamlyn Centre for Design's user network – their vision, hearing, dexterity, mobility and cognition capabilities correspond to different scales on Cambridge University's population capability data and their life experiences can act as an inspiration for designers.

An Activities section uses the centre's extensive track record of inclusive design projects to present precedents and case studies related to the activities of daily living. Insights on user behaviour are grouped under four themes - Personal Care, Household, Work & Money and Communication – and communicated via images, video and first-

person testimonial. Loughborough's Context Framework is presented here.

A Methods section maps and evaluates common design methods in practice and classifies them within a special framework. Designers can browse exemplar projects related to each method and identify the most appropriate method for their current project. Finally, an Ethics section offers designers guidance on good practice in working with people. Designers can work through the stages of contact, consent, confidentiality and conduct step-by-step in order to understand the principles of user involvement. Alongside the development of the web resource, which invites contributions from designers and seeks to build an online community of practice, the RCA research team also developed and tested an educational workshop for design students, The Methods Lab, which works in tandem with the web tool.

3. Testing the design tools

To test the relevance and usefulness of its design tools, the research team wrote a hypothetical inclusive design brief and commissioned a London-based product design firm, Vitamins, to pilot the toolkit in exploring a solution.

The brief was code-named Cold Work and asked this question – how do you find a novel and inclusive way to remove ice from a car windscreen on a cold winter's morning without resorting to the standard, environmentally-unfriendly can of aerosol? A three-strong design team from Vitamins spent two days at the Royal College of Art in July 2010 working on the brief. It was the height of summer with temperatures above 30°C. So how did they get on?

The two days were set up to simulate the initial explore-and-create phases of a typical design project, in which the designers would scope out the work, conduct some preliminary exercises in user interaction, sketch and model some early concepts, and plan more in-depth user research. The i~design 3 research team was on hand to explain the tools as the designers worked on the project and the exercise was filmed. Right at the outset the design team got to grips with Cambridge's Demand Assessment Tool – this enabled them to use simple cards to map out the user experience of de-icing a car stage by stage. Each stage was broken down in terms of the demands on vision, dexterity, cognition and so on, alerting the designers to what might cause people problems.

Having assessed the nature of the task, the designers then tried out a range of existing solutions – scrapers, aerosol cans and so on – donning Cambridge's special impairment simulation gloves and glasses to experience various impairments for themselves and learn at first hand their impact on performance. By trying to open car doors, read instructions or drag a scraper across a car windscreen while impaired, the designers began to understand the challenges that many people face in using products every day. 'The tools feel very familiar to the way we normally work,' confirmed designer Duncan Fitzsimons of Vitamins. 'There is a good fit with our creative process but the tools

make sure that we look at every stage of the task thoroughly and methodically. That fuzzy front end of design is made more formal and less ad hoc.'

An early breakthrough for the design team came with the insight that scraping ice off a windscreen required two different types of force – chipping to break the ice and scraping to wipe it away. Neither existing scrapers nor aerosols allowed for such dual action. The designers now turned their attention to the context of use – light is likely to be poor on a cold winter's morning and icy conditions might make handling and operating a device even harder. Loughborough Design School's Context Calculator came into its own at this point as the design team investigated what size of text and colour of background would include the most people in reading instructions in poor light, and what cold hands might do to the level of dexterity. 'It's reassuring to have the numbers right at hand, to have empirically tested data that lets you make the right design decisions,' explained Fitzsimons. 'We're condensing hours of trial-and-error work into a few simple calculations

with this tool. I'd use the Context Calculator not only at the early stages of design but also during the testing of prototypes.'

Having explored the context of using a de-icer at dawn in winter, despite working on a hot summer's day, the design team now sought inspiration and ideas from a different source. They explored the RCA open-access web resource, www.designingwithpeople.org, looking first at a section called Activities for a match to de-icing a car. Here, they found a wealth of material on Home Maintenance and watched a video of an older driver standing upright and washing his car with an extended power washer. This chimed with an idea the team had to create a longer and more ergonomic handle for the scraper itself to give access to the car window without leaning over.

In the People section, the designers read profiles of real people with different capabilities. Susan, a 76 year old car driver with mild osteoarthritis, appealed directly to the team from the website: 'Involve the envisioned user at the beginning and throughout the design process,' she implored in a Message to Designers, 'so that things that don't work or could work better are discovered long before the design reaches the production stage.' Chris, who is 63 and registered blind, called for simpler, easier interfaces.

As the project challenge took shape, the designers turned their attention to devising some in-depth user research to be undertaken once the two-day pilot with the i~design 3 toolkit was over. By now they had sketched out a range of design concepts, including a heated de-icing tool, a vibrating scraper and a sheet of removable cellophane that you simply peel off the windscreen. The frontrunner turned out to be an idea called Scraper-Plus: this uses a levered ball action to create

two types of force – chipping and scraping. This was modelled in card to see how it feels in the hand.

The design team returned to the RCA website to review different design methods that engage users in the creative process. They followed a simple framework to assess which methods are right for the next stage of their project. They also looked at the Ethics section for practical advice on how to contact older user groups, how to gain their consent and how to treat them with respect. A standard consent form was downloaded that Vitamins could adapt for their own use. The design team was ready to take the project to the next stage – an in-depth study of user behaviour. The two days were over. The i~design3 toolkit had given them hard data on the demands of the task and on the context of use; it had given them a simulated insight into the human experience of impairment as well as rich practical information and support on designing with people – precedents, cases, methods and ethics. Critically, the tools had supported the generation of early-stage design concepts. At a later stage in the project, once a new de-icing product has been designed, the team would be able to use the Exclusion Calculator to carry out an Exclusion Audit to evaluate its effectiveness prior to market introduction. 'The whole point of the i~design tools is that they work together – they respond to the fluid and iterative way in which designers gather and synthesise information,' commented Duncan Fitzsimons of Vitamins Design. 'This pilot has been a useful exercise which has opened our eyes to how much it takes to make a truly inclusive product.'

4. Conclusions

The involvement of a professional design team and the setting up and filming of a directed two-day design project provided to be a useful method to test and get feedback on the design tools generated by the

third phase of the i~design project. To see such resources as the Inclusive Design Toolkit, the Context Calculator and the Designing With People website being used in real-time during a design exercise gave the research team new insight into how such tools might be refined and communicated to the design industry.

As much design consulting activity moves 'upstream' to the explore-and-create phase of the innovation process – the fuzzy 'front end' of innovation – such insights resulting from a short excursion into design exploration of a familiar problem are invaluable. More generally, the outputs of the i~design project are helping to change the landscape of inclusive design and future research will focus on the application of i~design tools and techniques to real-world design contexts within the fields of healthcare and mobile and other communication technology. Considerable industrial and EU funded work is already propagating i~design into many and varied knowledge transfer and assistive technology applications.

i~design 3 research team

Engineering Design Centre, University of Cambridge: Prof John Clarkson; Dr Pat Langdon; Ian Hosking; Dr Sam Waller; Dr Joy Goodman-Deane

The Well-being Institute, University of Cambridge: Prof Felicia Huppert; Dr Raji Tenneti

Loughborough Design School, Loughborough University: Colette Nicolle; Eddy Elton

Helen Hamlyn Centre for Design, Royal College of Art: Prof Jeremy Myerson; Dr Yanki Lee

i~design websites

www.inclusivedesigntoolkit.com

www.designingwithpeople.org

Designing New Technologies within a Participatory Approach

Dr. Claudia B. Rebola

Assistant Professor

School of Industrial Design, Georgia Institute of Technology

247 4th St NW Room 254 Atlanta GA 30332

e-mail: crw@gatech.edu

Claudia B. Rebola is Tenure Track Assistant Professor in the School Industrial Design at Georgia Institute of Technology. She received her B.A. on Industrial Design from the Universidad Nacional de Cordoba, and her M.S. on Industrial Design and Ph.D. on Information Design from North Carolina State University. She is founder and organizer of the Design and Technologies for Healthy Aging (DATHA) coalition initiative and director of the D-Matters Studio Lab housed at the Centre for Assistive Technologies and Environmental Access (CATEA). Her focus is on design for aging and her research areas include interactive design, socialization and communication technologies and intergenerational design. At her lab, universal design, tangible interfaces, and participatory and co-design methods are employed. Her interests are in the application of those methods towards humanizing

technology, empowering users and celebrating the value of simplicity and tangibility in user-product interactions.

Jon Sanford

Director and Associate Professor

Centre for Assistive Technologies and Environmental Access (CATEA)

School of Industrial Design, Georgia Institute of Technology

490 10th St Atlanta GA 30332

e-mail: jon.sanford@coa.gatech.edu

Jon Sanford is an Associate Professor in the School of Industrial Design at Georgia Tech where he is the Director of the Centre for Assistive Technology and Environmental Access (CATEA). He is also a Research Architect at the Rehabilitation Research and Development Centre at the Atlanta Veterans Affairs Medical Centre. Mr. Sanford has been actively involved in research, teaching and practice for over 25 years and is well-recognized for his expertise in universal design, accessible design and assistive technologies. He was one of the authors of the Principles of Universal Design and teaches courses in both universal design and design for healthy aging in the community. His research spans the design of products and spaces, such as housing, including the effectiveness of home modifications for aging in place; public facilities including seating is stadiums and theaters; and community settings where he has focused on environmental barriers to community mobility.

Karen Milchus

Research Engineer II

Centre for Assistive Technologies and Environmental Access (CATEA)

School of Industrial Design, Georgia Institute of Technology

490 10th St Atlanta GA 30332

e-mail: karen.milchus@coa.gatech.edu

Karen Milchus is a senior research engineer at Georgia Tech's Centre for Assistive Technology and Environmental Access (CATEA), where she has been working for the past seventeen years. When not reminding people to make their travel arrangements for accessible voting technology workshops, she serves as the PI and Co-Director of the Rehabilitation Engineering Research Centre on Workplace Accommodations (Work RERC). She specializes in identifying and providing vocational and educational accommodations to adults and youth with disabilities, with a particular focus on computer-based solutions. Ms. Milchus has provided assistive technology services for state vocational rehabilitation agencies in Georgia and Wisconsin. She is also Vice-Chair of RESNA's Special Interest Group (SIG) on Accommodations.

Whitney Quesenbery

WQusability/ITIF Accessible Voting Technology Initiative

78 Washington Avenue High Bridge, NJ 08829

e-mail: whitneyq@wqusability.com

Whitney Quesenbery works as a user experience researcher and plain language expert for organizations such as the National Cancer Institute, IEEE and the Open University. A founder of the Usability in Civic Life project, she leads projects for election officials and advocates to improve the usability of ballots and other election materials. She served on the EAC Technical Guidelines Development Committee, developing the VVSG 2005 and Version 1.1. She is a co-author of the Brennan Centre Better Ballots report, and has worked on usability and design projects in Minnesota (absentee ballot instructions), New York (error messages), and training and ballot testing in several states. She also served on the Access Board's advisory committee to refresh the "Section 508" accessibility regulations, as President of the Usability Professionals Association and on the board of the Centre for Plain Language. She is the author of two books, Storytelling for User Experience and Global UX: Design and research in a connected world.

Daniel Castro

Senior Analyst

Information Technology and Innovation Foundation

1101 K Street NW, Suite 610, Washington, DC 20005

e-mail: dcastro@itif.org

Daniel Castro is the project director and principal investigator of the Accessible Voting Technology Initiative, and a senior analyst at the Information Technology and Innovation Foundation (ITIF), a non-profit think tank in Washington, DC. His research focuses on information policy, including issues such as data privacy, intellectual property, e-government, accessibility, and security. Before joining ITIF, Mr. Castro worked as an IT analyst at the Government Accountability Office (GAO) where he audited IT security and management controls at various government agencies. He has a B.S. in Foreign Service from Georgetown University and an M.S. in Information Security Technology and Management from Carnegie Mellon University.

Designing New Technologies within a Participatory Approach

Claudia Rebola[1], Jon Sanford[1,2], Karen Milchus[2], Whitney Quesenberry[3] and Daniel Castro[4]

1 School of Industrial Design, Georgia Tech

2 Centre for Assistive Technology and Environmental Access, Georgia Tech

3 WQusability/ITIF Accessible Voting Technology Initiative

4 Information Technology and Innovation Foundation

Abstract

Voting is a basic part of participating in a democracy, yet many people, including those with disabilities, face a variety of physical and social barriers to casting their ballot. To address this problem, multidisciplinary groups of researchers, election officials, vendors, advocates and voters with disabilities participated in a series of moderated participatory design workshops. This paper describes the outcomes of the workshops as they developed a variety of concepts to address the range of issues that impact accessible voting from registering to vote to accessing the polling place, to using voting technologies to casting a ballot.

1. Participatory Design Workshops

Given the accessibility problems still found in modern elections, a new approach is needed towards designing accessible voting technologies. The approach presented in this paper is based on developing participatory design workshops by putting together a multidisciplinary group of stakeholders and potential users through a series of structured analytical and creative activities for a short period of time.

Two, 1 and 1 1/2 day design workshops were held in two consecutive months. The workshops focused on developing new concepts for accessible voting systems. More specifically, the concepts were focused on one of four themes: the design of voting equipment, pre-election and on-site information, polling places, and absentee ballots to make the voting experience more accessible to people with disabilities. The workshops followed a structure with the use of various analytical and creative methods (Higgins, 1994; Martin & Hanington, 2012). Those methods included scenario-based design (Carroll, 2000), personas, and Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Integral to all of these methods was the grounding in the Principles of Universal Design.

A total of 35 participants attended each workshop. The workshop participants represented a broad spectrum of experiences and viewpoints. As such, people with disabilities were involved as users of voting systems as well as accessibility advocates, election officials, election workers, designers and researchers from technology, interaction, information, usability, graphics, architecture and other design fields, voting technology experts and voting system designers. Initially participants were assigned to a team focusing on a particular theme. However, participants were allowed to change teams during the workshop. To help participants best achieve these goals, industrial

design students were involved in each team. They helped visualize and showcase the teams' conversations by recording and diagramming ideas, keywords and concepts on paper, sticky notes, and boards. Using industrial design students also allowed stakeholders without prior design experience to more easily participate in the creative process.

2. Workshop Activities

The workshop activities allowed participants to design and develop new accessible technologies. Activities moved from identifying barriers, brainstorming solutions to overcome those barriers, selecting best concepts to refine, assessing the accessible aspect of the selected concept and presenting the final outcome. After selecting the best concepts, each team used the Universal Design assessment tool as a framework for validating the concepts.

Universal Design (UD) 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 (The Centre for Universal Design, 1997). The authors, a working group of architects, product designers, engineers and environmental design researchers, collaborated to establish seven principles that may be used to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments. Most recently, a UD assessment tool has been developed. Workshop teams were given a series of questions based on the assessment tool. Questions were varied representing the principles such as:

- *Can the concept be effectively used in a variety of ways?*

- *Can the concept be used at different paces (e.g. quickly or slowly)?*
- *Can the concept be used without hearing and vision?*
- *Does the concept prevent the user from committing errors?*

These questions forced teams to refine the accessibility of the concept by answering specific questions about designing accessible products. At the end, each team created a final detailed design concept, which was presented as a final poster to the entire workshop.

3. Design Outcomes

By creating a collaborative design process, the workshops produced solutions that have the potential to make the entire voting process more accessible for every citizen. Ten new design outcomes—concepts were produced by approximately 70 people in 3 days. The concepts were varied but all provided unique ideas and insights to advance the design of the next generation of accessible voting technologies. The next sections describe four of the design outcomes.

3.1 Ballot Design Technology for Marking the Ballot

This concept focused on analyzing and improving current ballot design technologies, including the physical design for an electronic screen for marking the ballot (see Figure 1).

Design criteria emerged from analyzing the current technologies. The team recommended that different types of races (e.g., federal, local, referendum), should be divided into manageable and controllable sections on the ballot. It was noted that candidate photos should be displayed to ensure correct recognition. In addition, information blurbs can also be displayed within the screen, without interrupting or confusing the user during the process of marking the ballot. They

proposed incorporating a completion bar in order for voters to understand where they are in the vote casting process and use a linear operation. The interface should be simplified with limited options and buttons in order to reduce chances for committing error and prompting completion of the form.

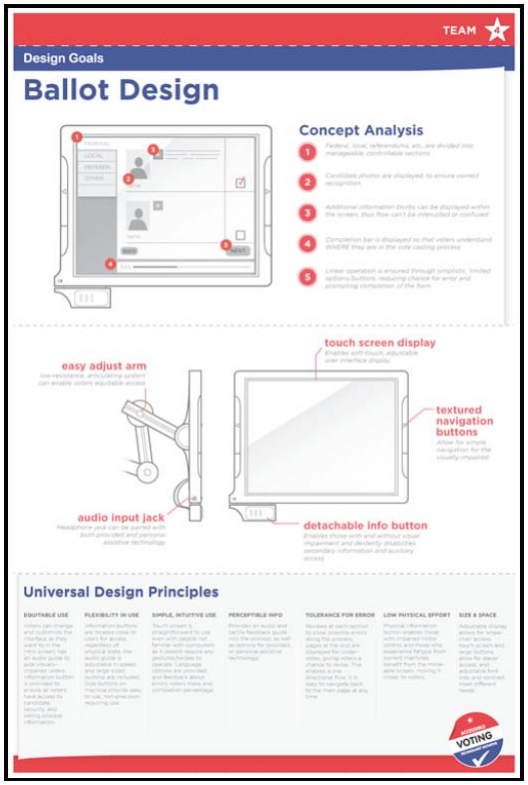


Figure 1: Ballot Design Technology Poster

The solution included a low effort adjustable arm with low-resistance articulating system to enable voter's equitable access. An audio input jack was incorporated for headphone jacks to be paired with both provided and personal assistive technologies. A touch screen display was utilized since it enables soft touch and adjustable user interface display. Textured navigation buttons were part of the design to allow for simple navigation for the visually impaired. Lastly, a detached information button enabled those with and without visual impairment

and dexterity disabilities secondary information and auxiliary access. As part of the concept validation the UD principles were explained, as follows:

- *Principle One Equitable Use: Voters can change and customize the interface as they want to in the intro screen, has an audio guide to aid visually impaired voters. Information button is provided to ensure all voters have access to candidate, security, and voting process information.*

- *Principle Two Flexibility in Use: Information buttons are located close to users for access regardless of physical state, the audio guide is adjustable in speed, and large-sized buttons are included. Side buttons on the machine provide easy to use and non-precision requiring use.*

- *Principle Three Simple and Intuitive Use: Touch screen is straightforward to use even with people not familiar with computers, as it doesn't require any gestures/swipes to operate. Language options are provided, and feedback about errors voters can make and completion percentage.*
- *Principle Four Perceptible Information: Provides an audio and tactile feedback guide into the process, as well as options for provided, or personal assistive technology.*

- *Principle Five Tolerance for Error: Reviews at each section to show possible errors along the process, pages at the end are displayed for under votes, giving voters a chance to revise. This enables a one directional flow. It is easy to navigate back to the main page at any time.*

- *Principle Six Low Physical Effort: Physical information button enables those with impaired motor control and those who experience fatigue from current machines benefit from the moveable screen, moving it closer to voters.*

- *Principle Seven Size & Space for Approach and Use: Adjustable display allows for wheelchair access, touch screen and large buttons allow for easier access, and adjustable font size, and contrast meet different needs.*

3.2 Rich Ballot Design for Voting Remotely

This concept focused on designing a system for voters to be able to vote anytime, anywhere, anyway by anyone. The voting process starts by downloading a rich ballot with helpful support that guides the voter through marking the ballot, reviewing and verifying the ballot, and printing of the ballot (see Figure 2).

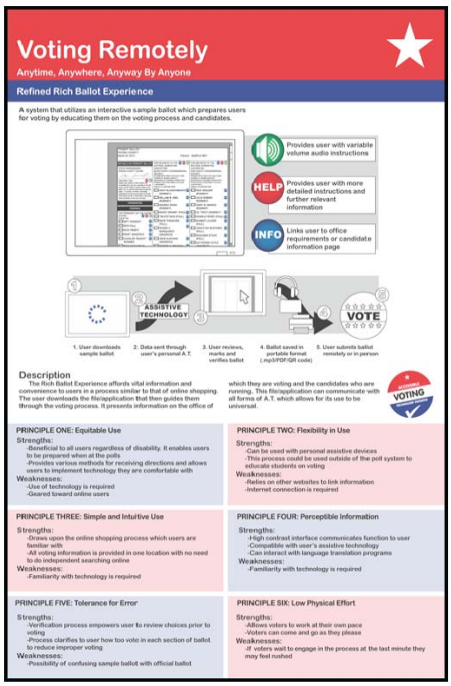


Figure 2. Rich Ballot Designed Technology Poster

This concept is a system that utilizes an interactive sample ballot, which prepares users for voting by educating them on the voting process and candidates. The ballot includes help icons that provides users with variable volume audio instructions (for each contest or question), detailed instructions and further relevant information (for each contest or question), and links users to office requirements or candidate information page (for each contest or question, and for each candidate). The Rich Ballot Design affords vital information and convenience to users in a process similar to that of online shopping. The user downloads the file/application that then guides them through the voting process. It presents information on the office of which they are voting and the candidates who are running. This file/application can communicate with all forms of assistive technology (AT) which allows for its use to be universal. This concept advances a few steps for operation. The process of voting using the rich ballot process includes the following steps: 1) user downloads the sample ballot; 2) user marks the ballot using a personal AT; 3) user reviews, marks and verifies the ballot; 4) user saves the ballot in a portable format (mp3/PDF/QR code); and last 5) user submits the ballot remotely or in person. As part of the concept validation the UD principles were explained, as follows:

- *Principle One Equitable Use: The concept is beneficial to all users regardless of disability. It enables users to be prepared when at the polls. It provides various methods for receiving directions and allows users to implement a familiar technology. Some weaknesses include the required use of technology, and how is geared toward online users.*
- *Principle Two Flexibility in Use: The concept can be used with personal assistive devices. This process could be used outside of the poll system to educate students on voting. Some weaknesses*

are that relies on other websites to link information and Internet connection is required.

- *Principle Three Simple and Intuitive Use: The concept draws upon the online shopping process which users are familiar with. All voting information is provided in one location with no need to do independent searching online. Some weaknesses include that familiarity with technology is required.*

- *Principle Four Perceptible Information: The concept portrays a high contrast interface to the user. It is compatible with user's assistive technology. Users can interact with language translation programs. Some weaknesses include that familiarity with technology is required.*

- *Principle Five Tolerance for Error: The verification process empowers the user to review choices prior to voting. The process clarifies to the user how to vote in each section of the ballot to reduce improper voting. Some weaknesses include the possibility of confusing a sample ballot with official ballot.*

- *Principle Six Low Physical Effort: The concept allows voters to work on their own pace. Voters can come and go as they please. Some weaknesses include that if voters wait to engage in the process at the last minute they may feel rushed.*

3.3 Personal Voting Guidance System Design for Preparing to Vote

This concept is a personalized experience that promotes effective voter participation from the start of the campaign to casting a vote. It starts any time a voter is motivated to participate (see Figure 3). The goal of

this Personal Voting Guidance System is to promote effective voter participation. There are many things that might motivate someone to think about an election, sometimes long before the ballots are available. The Personal Voting Guidance System stitches all of this information together from the first contact through the availability of ballots to the actual election.

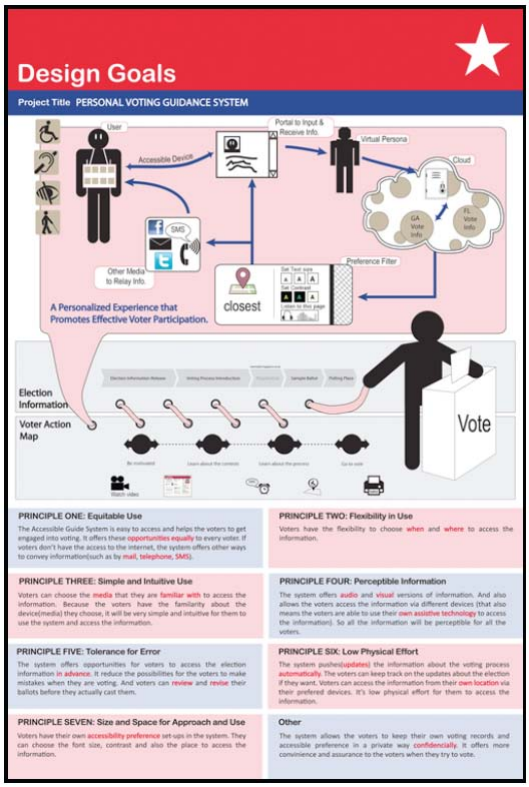


Figure 3. Personal Voting Designed Technology Poster

Election information is available in stages. When the election is announced, the system would know the contests, the process of the election and the campaigns. At a specific point, the ballot is published with the final list of candidates. Then, the election takes place over several days or on a single day. Voters also go through a process which includes being motivated to consider the election and learning about the contests, candidates, and the voting process. Lastly, users

go to vote. The Personal Voting Guidance System can be used at any time to store research and choices for an election. It is fully accessible, allowing voters to use any accessible device and any media to relay information. A voter can create a "virtual persona" to store information in the cloud about their preferences for display, location or media. The Personal Voting Guidance System meets the universal design principles, applying them to participating in elections. As part of the concept validation the UD principles were explained, as follows:

- *Principle One Equitable Use: The system is easy to access and helps the voters get engaged in voting. It offers these opportunities equally to every voter. If voters don't have access to the Internet, the system offers other ways to convey information (such as by mail, telephone, SMS).*

- *Principle Two Flexibility in Use: Voters have the flexibility to choose when and where to access the information.*

- *Principle Three Simple and Intuitive Use: Voters can choose the media that they are familiar with to access the information. Because the voters will be familiar with the devices they choose, it will be simple and intuitive for them to use the system and access the information.*

- *Principle Four Perceptible Information: The system offers audio and visual versions of information. And also allows voters to access the information via different devices (that also means the voters are able to use their own assistive technology), so all information will be perceptible for all voters.*

- *Principle Five Tolerance for Error: The system offers opportunities for voters to access the election information in advance. It reduces the possibility for mistakes when voting. Voters can review and revise their ballot choices before actually casting the ballot.*

- *Principle Six Low Physical Effort: The system pushes (updates) information about the voting process automatically. Voters can keep track of updates about the election that they want. Voters can access the information from their own location via their preferred devices. It's low physical effort for them.*

- *Principle Seven Size and Space for Approach and Use: Voters have their own accessibility preference setups in the system. They can choose the font size, contrast, and also the place to access the information.*

- *Other: The system allows voters to keep their own voting records and accessible preferences in a private way, confidentially. It offers more convenience and assurance to the voters when they try to vote.*

3.4 Adaptive Voting Toolkit for Voting In Person

This concept aims at enhancing community voting participation and knowledge through education and training starting in grammar school (see Figure 4). The Adaptive Voting Toolkit is used to increase knowledge about the voting process by the use of different mediums. This Toolkit will enable students to become more knowledgeable as well as introduce disability education. For the young student level, this toolkit may contain things such as games and books and be implemented into class work. Adapting for higher education, this

toolkit may include mock voting materials to increase knowledge. Students at this age may need incentives or rewards associated with their participation. The final phase of this toolkit is to be a guide and setup processes for poll workers. These workers have varying abilities and needs that are considered during training and setup. This toolkit will also include material on accessibility education and awareness.

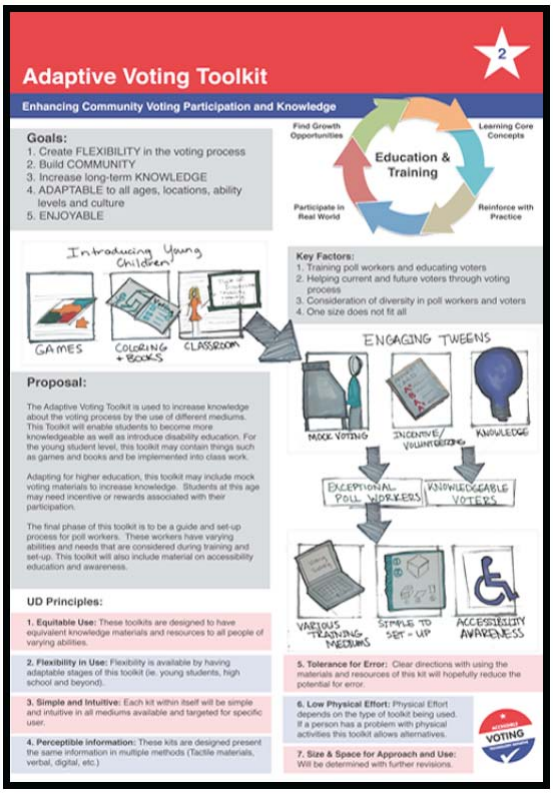


Figure 4. Adaptive Toolkit Designed Technology Poster

The goal of this project was to create flexibility in the voting process. Central to this concept was the need to build a community for voting in person and increase long-term knowledge. In order to respond to these needs, the envisioned solutions should portrayed not only adaptability to all ages, locations, ability levels and culture, but also enjoyable from different perspectives. As such, the solutions should include various training media, simple to set up systems and

accessibility awareness Key factors to develop the concept included the following: training poll workers and educating voters, helping current and future voters through voting process; considering diversity in poll workers and voters; advancing one size does not fit all; educating and training users based on a cycle of learning core concepts, reinforce with practice, participate in the real world, and find growth opportunities; including learning activities as the children grow up by introducing young children through games, colouring books and classroom training; engaging teens through mock voting, incentive volunteering, knowledge building; including older teens as poll workers and knowledgeable voters. As part of the concept validation the UD principles were explained, as follows:

- *Principle One Equitable Use: These toolkits are designed to have equivalent knowledge materials and resources to all people of varying abilities.*

- *Principle Two Flexibility in Use: Flexibility is available by having adaptable stages of this toolkit such as for young students in high school and beyond.*

- *Principle Three Simple and Intuitive: Each toolkit within itself will be simple and intuitive in all mediums available and targeted for specific users.*

- *Principle Four Perceptible information: The concept is designed to present the same information in multiple methods (tactile materials, verbal, digital, etc.)*

- *Principle Five Tolerance for Error: Clear directions with using the materials and resources of this kit aims at reducing errors.*

- *Principle Six Low Physical Effort: This concept argues that the physical effort depends on the type of toolkit being used. If a person has a problem with physical activities this toolkit allows alternatives.*

4. Acknowledgements

The work in this paper has been sponsored by the United States Election Assistance Commission and supported by the Information Technology and Innovation Foundation (ITIF) and the Centre for Assistive Technologies and Environmental Access (CATEA) at Georgia Tech. Special thanks to all students from the School of Industrial Design at Georgia Tech who made the workshops a success. More information about this project can be found at http://elections.itif.org/.

5. References

Carroll, J. M. (2000). *Making use : scenario-based design of human-computer interactions*. Cambridge, Mass.: MIT Press.

Higgins, J. M. (1994). *101 creative problem solving techniques : the handbook of new ideas for business*. Winter Park, Fla.: New Management Pub. Co.

Martin, B., & Hanington, B. M. (2012). *Universal methods of design : 100 ways to research complex problems, develop innovative ideas, and design effective solutions*. Beverly, MA: Rockport Publishers.

The Centre for Universal Design, N. C. S. U. (1997). The Principles of Universal Design Retrieved March 25, 2012, from http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm

Visocky O'Grady, J., & Visocky O'Grady, K. (2006). *A designer's research manual succeed in design by knowing your clients and what they really need*. Gloucester, Mass.: Rockport Publishers.

Willerer, T. (2009). The Seven Rules of Brainstorming (from IDEO), from http://tomwillerer.com/post/145531080/the-seven-rules-of-rainstorming-fromideo

Activities of Daily Life Still Cause Problems for Many Older and Physically Impaired People

Dr R. E. Sims

Research Associate

Loughborough Design School, Loughborough University, LE11 3TU, email: r.e.sims@lboro.ac.uk

Ruth has been a research associate at Loughborough University since 1999, with a first degree in psychology, masters in ergonomics and PhD in 'design for all'. She has mostly been involved in research into accessibility and usability of products, systems and environments by older or physically disabled people, but has also worked on projects investigating road safety in emerging economies, the reinvention of the toilet for low-water areas, and co-design to generate ideas for reducing single occupancy car travel when commuting to work. Ruth feels passionately about starting with the end-user and considering their needs and wants as the basis for successful design.

Dr D. E. Gyi

Reader in Health, Ergonomics and Design

Loughborough Design School, Loughborough University, LE11 3TU, email: d.e.gyi@lboro.ac.uk

Diane Gyi (PhD, MSc, DipCOT) is a Reader in Health Ergonomics and Design in the Design School at Loughborough University. She has published widely on inclusive design, vehicle ergonomics, posture and seating, and musculoskeletal health with funding from EPSRC, the BUPA Foundation and the HSE. Her research has involved close collaboration with industry in the automotive, construction and general manufacturing sectors. She is a Scientific Editor for Applied Ergonomics, and a member of the Editorial Board for the International Journal of Industrial Ergonomics.

Dr R. Marshall

Senior Lecturer

Loughborough Design School, Loughborough University, LE11 3TU, email: r.marshall@lboro.ac.uk

Dr Russell Marshall is a senior lecturer and head of the Design Ergonomics Group in the Design School at Loughborough University. His research interests cover a broad range of topics within Product, Industrial and Engineering Design including: Digital Human Modelling and tools and techniques for facilitating and empowering designers in human-centred and inclusive design practice; Ergonomics and Human Factors in design, Modular product design, and drawing and visualisation. Russell is also principal developer of SAMMIE the digital human modelling system.

Professor Keith Case

Professor of Computer Aided Engineering

Wolfson School of Mechanical & Manufacturing Engineering, Loughborough University, LE11 3TU,

email: k.case@lboro.ac.uk

Keith Case is Professor of Computer Aided Engineering in Mechanical and Manufacturing Engineering at Loughborough University and is a Chartered Engineer, Fellow of the Ergonomics Society and a Fellow of the British Computer Society. In 1994 he received the Ergonomics Society Otto Edholm Award in recognition of his significant contribution to the development and application of ergonomics, primarily in the area of virtual human modelling. His other research interests include knowledge-based manufacturing engineering and design, human modelling and manufacturing ergonomics.

Activities of Daily Life Still Cause Problems for Many Older and Physically Impaired People

Sims, R.E[1], Gyi, D.E. [1], Marshall, R. [1] and Case, K.[2]

1 Loughborough Design School, Loughborough University, Loughborough, UK, LE11 3TU

2 Wolfson School of Mechanical & Manufacturing Engineering, Loughborough University, Loughborough, UK, LE11 3TU

Abstract

Activities of Daily Life (ADL) are those activities that are fundamental to maintaining independence. Without being able to do them, people can become dependent on others or simply not live their lives in the way that they would wish to. A survey of 50 older and disabled people found that surprising numbers were unable to fulfil the level of independence in ADL that they wished to. For all the advances in the recent age in technology and equipment design, these basic activities are still proving too difficult for a sizeable percentage of the older/disabled population. As the population ages, pressure will come to bear on designers to consider the needs of older/disabled people more fully, to meet the needs of the shifting market trends.

1. Introduction

McGlone (1992) estimated from survey results (conducted by the Office of Population Censuses and Surveys) that there were 6.2 million disabled adults in Great Britain, with more than two-thirds of them aged 60 years and over. Vanderheiden (1990) states that over 30 million people in the USA have disabilities or functional limitations, either from birth, accident and illness, or through old age. The population is also ageing: in the United Kingdom in 2006 11 million people were over retirement age (60 years old and over for men, 65 years and over for women. Office for National Statistics, 2005), and it is estimated that, worldwide, by 2050 the number of people aged 60 years and over will be 2 billion (World Health Organisation, 2008). Many of those people currently aged 50-75 will have access to disposable income (Walker & Maltby, 1997), a view which Ward (2001) concurs. The “new old”, those who grew up in the 1950s and 1960s, have a disposable income, coupled with high expectations of the quality and effectiveness of the products they buy and use.

Katz *et al* (1963) first created the Index of Activities of Daily Life to provide a guide to chronic illness, for studying the ageing process, and to assist with rehabilitation. Since this first index was created, the study of ADL has increased to cover all activities that are essential for independence, and its assessment can be used to reflect the ability of the individual to live in their own home with or without assistance. ADL can include using the toilet, eating, walking, dressing, bathing, and grooming, although these can vary between studies. Instrumental ADL (IADL, Clark, Czaja & Weber, 1990) include activities such as cooking, shopping, using transport, taking medication, using the telephone, housekeeping, doing laundry, and managing money. ADL are those activities that are essential for independent living, whereas

IADL are more involved and imply capacity to make decisions as well as greater interaction with the environment (WHO, 2001).

A number of studies in have investigated the types and prevalence of ADL that people have problems with, and the use of assistive devices (Dawson, Hendershot and Fulton, 1987; Clark, Czaja and Weber, 1990; Sonn & Grimby, 1994; Millán-Calenti *et al*, 2000). In their study, Millán-Calenti *et al* (2000) found that 19.1 % of men and 16.1 % of women were unable to prepare meals, 9.4 % of men and 18.1 % of women were unable to shop, 37.5 % of men and 23.4 % of women were unable to do their laundry, 6.3 % of men and 12 % of women were unable to dress themselves, 9 % of men and 19.9 % of women were unable to bathe unaided, and 2.7 % of men and 9.4 % of women were unable to transfer.

The aim of the survey conducted was to discover the problems that older and disabled people have with products, environments, and the activities of daily life that they would most like to be able to do (within the realms of any impairments they had). The data collected were used to inform the design of a data-collection protocol, to provide the basis for the development of a computer-based design tool, HADRIAN (Porter *et al*, 2004).

2. Methods

50 people took part (30 women, 20 men), and face-to-face interviews were conducted during which they were asked a mix of open-ended questions and those with more discrete responses. The questionnaire was divided into seven sections: general personal details, kitchen, bathroom, general in the house, away from home, work, and leisure. Each question was given a scale for the interviewer to mark, according to the person's response (numerical, from 1 to 5, with 1 indicating that

a task was accomplished easily and with no problems, and 5 indicating that a task was impossible). This scale is almost identical to that proposed by Lenker and Paquet (2001) in a discussion of sampling methods, and the scale was marked by the interviewer depending on the response. Additional comments were noted, and at the end of each group of questions from the seven sections, participants were also asked if there was any one thing (at a practical level) that they would like to be able to do but could not achieve.

3. Results

56 % of the participants were of working age (18-65 years of age), but of these only nine actually worked. The other 44 % reported either being retired early or unable to work due to their disability.

Age range (years of age)	**Number of men**	**Number of women**
18-62 (with disability)	13	15
63 + (with disability)	2	8
63 + (without disability)	5	7
TOTAL	20	30

Table 1: Ages and genders of older and disabled participants (n=50)

30 % of participants reported not being reliant on other people on a daily basis at all, remaining very independent. 60 % reported needing assistance in some tasks only, usually involving activities such as cooking, cleaning, gardening, bathing, and shopping. It was, however, of concern that 10 % of the participants reported being 'very reliant on

other people' at home on a daily basis, requiring almost continual assistance in daily activities.

In kitchen tasks, 32 % of participants found it impossible to reach a high shelf. Many participants mentioned methods of coping with ADL problems:

- Long-lever taps were used by the 28 % of participants
- 20 % of participants would only lift very light items into the oven (for example, a tray of chips was mentioned by one person)
- 14 % of participants would slide rather than lift a pan onto the hob
- 12 % of participants could put washing in and out of the washing machine without assistance but were reliant on another person to hang it to dry
- 10 % of participants had 'considerable problems' with washing up, and so had a dishwasher
- Kettle tippers were used by the 6 % requiring 'some help' to lift a kettle
- 'Grabbers' were used by the 6 % requiring 'some help' to reach high items

When asked about bathroom activities, it was discovered that five participants did not own a bath, four did not own a shower, and three participants were catheterised so did not use the toilet. Only 4 % of participants were able to get in/out of the bath 'easily', as opposed to 18 % who reported being able to use the shower 'easily'. Strategies for coping with difficulties with bathroom activities included:

- 40 % (4 out of the 10 participants who reported having 'some problems' using the toilet) had rail(s) nearby to grab onto

- 20 % of participants reported having a seat in the shower
- 20 % of participants needed ‘some help’ to use the toilet, and had a raised toilet seat and/or a frame around the toilet to hold onto
- 14 % of participants needed ‘some help’ using the bath, and had rails fitted and/or a seat
- 14 % of participants required ‘considerable help’ using the bath, and had a hoist or lift to get them in and out
- 12 % of participants had level-floor showers that could be walked or wheeled into
- 6 % of participants needed ‘considerable help’ to use the toilet, and had a hoist to lift them

Participants took part in a wide range of leisure activities, with only five people saying that they did not really do anything, due to physical constraints. Sporting activities were enjoyed, with 22 % of responses being activities such as walking, cycling, dancing, bowls, swimming, paragliding, and wheelchair racing.

Participants were asked what they would really like to be able to do, given their abilities, on a practical daily level. The responses to these questions (it was asked after each main section of the questionnaire) reflect those things that people most wanted to be able to do, in order to maintain independence and live their lives in the way that they wanted to. The total number of responses was 68, with most participants giving more than one response (38 of the 50 participants responded). Responses varied widely, but different participants mentioned several of the same items:

- 32 % (12 out of 38) of participants wished to use the oven more fully, possibly with a midlevel oven, for activities such as baking

- 18 % (7 out of 38) of participants wanted to be able to use their baths themselves or have equipment to make bathing easier
- 16 % (6 out of 38) of participants wanted the ability to take holidays, to have access to, and receive care when away from home
- 10 % (4 out of 38) of participants expressed a wish for each of:
- Access to the cinema
- Access to swimming
- Access to public transport
- To have a walk-in, level-access shower
- 8 % (3 out of 38) of participants expressed a wish for each of:
- To have lower work surfaces to make cooking and food preparation easier
- To have lower or no kerbs
- 'Access to all areas'
- Access to smaller shops
- 5 % (2 out of 38) of participants expressed a wish for each of:
- To be able to reach high cupboards
- Being able to wash own hair
- Being able to do the ironing
- Being able to change light-bulbs
- Being able to hang clothes on the washing line
- Being able to reach shop shelves

4. Discussion

It must be noted that the sample of 50 participants were nearly all from the East Midlands region of the UK, and as such may not be representative of the needs, wishes and problems experienced by older and disabled people countrywide. However, there was a consensus between many of the problems and wishes mentioned by participants,

and so it is felt that it is likely that the results broadly reflect the problems, concerns and desires of the wider population.

Problems with such activities of daily life such as shopping, cooking, laundry, and using transport all featured highly in this study, as they do in previous research. As an example, Millán-Calenti *et al* (2000) found that 37.5 % of men/23.4 % of women of their 598 older (but not necessarily disabled) participants reported problems with doing the laundry, 9 % of men/19.9 % of women reported problems with bathing unaided, 9.4 % of men/18 % of women reported being unable to shop, and 19.1 % of men/16.1 % of women had problems with meal preparation. These findings can be compared to the results of this research, in which (total) 36 % reported problems with, or found it impossible to use a washing machine, 52 % reported problems with bathing, 48 % reported difficulties when shopping, and 64 % had problems or found it impossible to use an oven. Dawson, Hendershot and Fulton (1987) also found the highest reported percentage of problems were with shopping, bathing and preparing meals. Cooking was the most frequently requested activity that the participants in this research really wanted to be able to do. Millán-Calenti *et al* (2000) and Clark, Czaja & Weber (1990) classified cooking as an instrumental ADL, rather than a fundamental one, whereas in this study it appears that cooking was considered fundamental to independence, given that when asked what they would most like to be able to do, more people mentioned cooking.

The use of assistive devices in the bathroom (20 % had a seat in the shower, 26 % had rails and/or raised seat and/or frame on the toilet) reflected the findings of Sonn and Grimby (1994), which found that the most prevalent assistive devices were ones to aid bathing and toileting. The need for raised toilet seats also indicates that the work

of people such as McClelland and Ward (1976, 1982) into recommendations for toilet seat heights is needed, as this is still an issue.

Reaching high items in the kitchen (and no doubt, in other rooms or in the supermarket) was impossible for 32 % of participants, and a further 34 % had problems with this activity. These results reflect the findings of Kirvesöya, Väyrynen and Häikiö (2000), who found that two-thirds of their 55 participants reported problems using the top shelf (1840mm) of their experimental kitchen.

Coping mechanisms such as sliding rather than lifting items (reported by 14 % of participants), and use of assistive devices (such as hoists and kettle tippers) featured often in participants' responses, indicating, as Powell Lawton (1990) suggested, that such behaviours and assistive devices need to be considered when assessing ADL. In addition to assistive devices in the bathroom, others used included dishwashers, kettle tippers, grabbers, and long lever taps. Coping strategies were such things as sitting to do tasks, sliding items rather than lifting, and asking for assistance when needed, and reflect the coping strategies found by the Government Consumer Safety Research (2000). 24 % of participants reported that having all electrical plug sockets at mid-level would be beneficial, and six participants had level-access showers to allow them to continue to enjoy showers. Those participants who were working expressed their ability to adapt and cope with problems such as cluttered work areas when moving in a wheelchair and slippery floor surfaces when walking with a stick. Changes to existing designs and 'standard practise' of room layout and design, may be beneficial to all users, and may become more prevalent as people pay for the changes themselves, and demand higher usability standards from those designing and building homes and offices. The very fact that 56 % of

the participants were of working age but only 18 % were actually in full-time work suggests that improved design and accessibility are needed in order to increase this number.

5. Conclusions

Many older and disabled people still have problems achieving ADL such as cooking, bathing, using transport, shopping, and using public amenities. Good design should be able to improve the situation for many older and disabled people. Examples where design changes have assisted people are level-access showers, mid-level ovens and mid-level electrical sockets. Older and disabled participants most wanted to be able to achieve the simple activities of daily life that so many of us take for granted, for example use their cooker more fully, and felt that design changes may assist them in achieving this.

It may be that older people do not always have the disposable income that would encourage designers to consider them as part of the 'market forces' or to force change (as predicted by Walker and Maltby, 1997; Clarkson *et al*, 2000; Rogers *et al*, 1997; Jordan, 2000; Vanderheiden and Tobias, 2000). These researchers predicted that market forces *would* result in change, and consideration of older and disabled people, but this would occur over time. As the older population grows, and the numbers of older people with larger disposable incomes grows, so the market will change. As anyone working in this area knows, this process is still ongoing, and market forces are yet to change dramatically, but it is still expected that it will happen and so consideration of the needs of older people will be key to successful product and service design and provision.

6. References

Clark, M.C., Czaja, S.J. & Weber, R.A. (1990) Older adults and daily living task profiles. *Human Factors*, 32(5), pp537-549.

Clarkson, P.J., Keates, S., Coleman, R., Lebbon, C. & Johnston, M. (2000) A model for inclusive design. *Engineering Design Conference*, 27-29 June, Brunel University, UK.

Dawson, D., Hendershot, G. & Fulton, J. (1987) Functional limitations of individuals age 65 years and over, *Advance data, Vital and Health Statistics* no. 133, Hyattsville MD: US Public Health Service.

Government Consumer Safety Research (2000) *A study of the difficulties disabled people have when using everyday consumer products*. Department of Trade & Industry.

Jordan, P.W. (2000) Inclusive design: a holistic approach. *Proceedings of the International Ergonomics Association/Human Factors and Ergonomics Society Conference, June 2000*, San Diego, CA, pp901-904.

Katz, S., Ford, A.B., Moskowitz, R.W., Jackson, B.A. & Jaffe, M.W. (1963) Studies of illness in the aged. The Index of ADL: a standardized measure of biological & psychosocial function. *Journal of the American Medical Association*, 185(12), pp914-919.

Kirvesöya, H., Väyrynen, S. and Häikiö, A. (2000) Three evaluations of task-surface heights in elderly people's homes. *Applied Ergonomics*, 31, pp109-119.

Lenker, J.A. & Paquet, V.L. (2001) Alternative approaches to sampling for anthropometric studies of persons with disability. *Proceedings of Anthropometrics of Disability: An international workshop*, Buffalo, NY, May 31-June 2.

Millán-Calenti, J.C., Tubío, J., Pita-Fernández, S., González-Abraldes, I., Lorenzo, T., Fernández-Arruty, T. & Maseda, A. (2000) Prevalence of functional disability in activities of daily living (ADL), instrumental activities of daily living (IADL) and associated factors, as predictors of morbidity and mortality, Archives of Gerontology and Geriatrics, 50 (3), pp306-310.

McGlone, F. (1992*) Disability and Dependency in Old Age: a demographic social audit*. Occasional paper 14, Family Policy Studies Centre.

Office for National Statistics (2005) *Great Britain; estimated resident population by single year of age and sex; Mid-2005 Population Estimates*.

Porter, J.M., Case, K., Marshall, R., Gyi, D.E. & Sims, R.E. (2004) '''Beyond Jack and Jill': designing for individuals using HADRIAN''*, International Journal of Industrial Ergonomics, 33, 2004,* 249-264.

Powell-Lawton, M. (1990) Aging and performance of home tasks. *Human Factors*, 32(5), pp527-536.

Roger, N., Ward, J., Brown, R. & Wright, D. (1997) Effective product design for an ageing market. *In* P. Soppala, ed. *From experience to innovation (volume 2)*, Proceedings of the 13th Triennial Congress of

the International Ergonomics Association, Tampere, Finland, pp243-245.

Sonn, U. & Grimby, G. (1994) Assistive devices in an elderly population studied at 70 and 76 years of age. *Disability and Rehabilitation*, 16, pp85-92.

Vanderheiden, G.C. (1990) Thirty-something million: should they be exceptions? *Human Factors*, 32(4), pp383-396.

Vanderheiden, G. & Tobias, J. (2000) Universal design of consumer products: current industry practice and perceptions. *Proceedings of the International Ergonomics Association/Human Factors and Ergonomics Society Conference, June 2000*, San Diego, CA, pp19-22.

Walker, A. & Maltby, T. (1997) *Ageing Europe*. Rethinking ageing series. Open University Press.

Ward, J. (2001) Generation gap. *Newdesign*, March-April 2001, pp50-53.

WHO (2001) International Classification of Functioning, Disability and Health (ICF), World Health Organisation, Geneva.

World Health Organisation. (2008*) The World Health Report. Primary Health Care: Now more than ever*. Geneva (World Health Organisation), ISSN 1020-3311.

Assistive Technology Product to Universal Design: A Way Forward

Mr George Edward Torrens, MCSD

Lecturer

Design Practice Research Group, Loughborough Design School

East Park Design School, Loughborough University

Loughborough, Leicestershire LE11 3TU

e-mail: g.e.torrens@lboro.ac.uk

George Edward Torrens is a Lecturer in Industrial Design and Technology in the School of Design, Loughborough University. He served a four-year engineering apprenticeship before studying Industrial Design at Newcastle Polytechnic. Whilst on a placement with Professor Jim Sandhu in 1986 he undertook his first design work relating to assistive technology. He built a rotational moulding rig to produce air cells for an adjustable modular seating system he had designed for children with cerebral Palsy. After graduating in 1988 he worked as contract furniture designer and technician before he joined the Brunel Institute for Bioengineering in 1990, working for Professor Heinz Wolff and Professor Ian Sutherland. During this time He worked

with Charities such as Action research, The Motor Neurone Disease Association, Arthritis Care and Age Concern. He also developed and patented a new form of splinting for Colles' fracture of the wrist. He joined Loughborough University in 1994. As a lecturer he has been involved in the research design and development of over 20 products for commercial healthcare and charitable groups as well as the United Kingdom Ministry of Defence. He is named inventor on four patents. He is currently a member of the Leicestershire and Rutland panel of REMAP GB, a charity producing one-off adaptions for people living with impairments and associated disability.

Assistive Technology Product to Universal Design: A Way Forward

George Edward Torrens
Loughborough Design School, Loughborough University,
Loughborough, LE11 3TU, United Kingdom

1. Introduction

The aim of this article is to provide those involved in Design for All with an insight into ways in which we may influence United Kingdom (UK) society to be more accepting of those who have impairment; and, make new product development (NPD) more viable. This article draws upon over 25 years' experience working with people who have impairments and live with disability. The context of Assistive Technology (AT) products are defined within a user-centred, new product development (NPD) process. The viewpoint of the user, associated stakeholders and a wider UK society are described along with ways in which their associated preferences may be obtained.

The focus of this article is Industrial Design practice. Industrial Design (ID) may be considered to deliver the social and cultural function of a product within the constraints of physical function, manufacture and cost. A key aspect of ID practice is the manipulation of an individual's emotions or behaviours through the user's experience of interacting with the product. This may be viewing or sensing through to using it to perform a task. The generic mechanisms of perception and emotional response to a product are discussed and mapped onto the given new product development (NPD) process. The semantics of words images and forms are shown to have a critical influence on the perception of

an individual and society. An example process, methodology and design tools are described that have been practically applied through many successful AT product developments. Case studies from current (2011-2012) Finalist undergraduate Industrial Design (ID) student product designs will focus on some of the principles described. The process described uses a combination of conventional evidenced-based NPD alongside specific methods of the manipulation of perception and semantic meaning. Design tools such as value web-diagrams, technology footprint, iconography and product DNA are demonstrated within the NPD examples.

2. New Product Development (NPD) Process

Before reviewing methods associated specifically with Assistive Technology and Universal design, it is helpful to provide a context for their application within a NPD process. Below is a 'double-diamond' approach to the explanation of NPD activities that has been refined and developed by the author over the last twenty years.

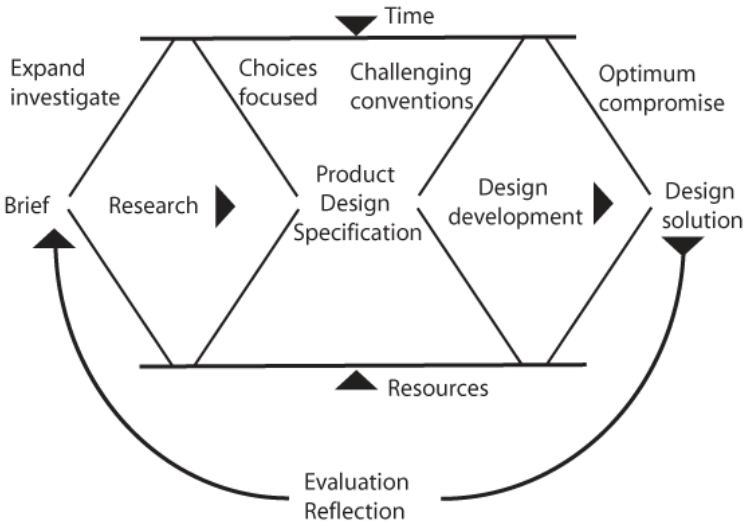


Figure 1: A diagram of new product development. (Torrens 2011)

This is similar the basic diagram used in more recent years by the UK design Council to explain NPD. The methods and tools highlighted in

this article focus on research, eliciting evidence to make informed design decisions; and, producing the optimum compromise within a design solution. In addition, design heuristics or tools are described that are employed to enhance the social and cultural function of the product design.

3. Assistive Technology and Universal Design

Assistive Technology (AT) product design may be considered a subset of Universal Design (Christophersen 2002) in that it provides a technology-based assistance to those with physical or cognitive impairment. This assistance is towards enabling a person to achieve Normal Activities of Daily Living (ADL's). Barnes (2011) noted that 'Normal' only appeared in the English dictionary in 1884.

Much of AT product design is currently focused on the physical function of a product. However, there are many commentators who have highlighted the issues in user acceptance of AT products. (Philips 1993, Fuhruer 2003). It is the author's experience that high quality engineered products that function safely and effectively in relation to a given task or purpose are often discarded when they do not have an appropriate component of social and cultural function. The social and cultural function is often referred to as style or the 'x' factor of a product.

Barnes (2011) has highlighted what appears to be endemic discrimination within UK society towards those considered disabled. From the definition of ID given earlier, it is clear Industrial Designers have the skills and knowledge to help change attitudes and behaviours in relation to AT products, leading to a change in UK society's perception of impairment and disability. Table 1. Highlights the issues raised by Barnes. The Barnes list has been matched with a list of ways

in which ID practitioners may overcome these challenges to effect social change.

4.0 Loughborough Assistive Technology-User Centred Design (LAT-UCD) methodology

The following methodology has been developed by the author over the last 25 years of working in the field of AT product design and is taught to undergraduate and post-graduate students. (Torrens 2000) Figure 2. provides a more detailed context for the application of the methods described. Table 1. Shows issues within AT product design and positive

Systemic and endemic discrimination	ID and Inclusivity
• Social discrimination (despite the Equality Act, 2010, UK) • Medical model and treatment reinforces segregation • Doctrine of human adaptability and fixed environment • Social model (late 20th Century-early 21st Century) • Innate social behaviour: weak/ill members disassociated from the main group • Perception: disability = weakness - leading to social stigma	• Social integration • Change perceptions • Manipulate psycho-social perception through colour, form, texture and sound • Change behaviours • Manipulate response and behaviours using social doctrines semantics, social value and association • Education and awareness • Role models

	• Change environment User centred focus

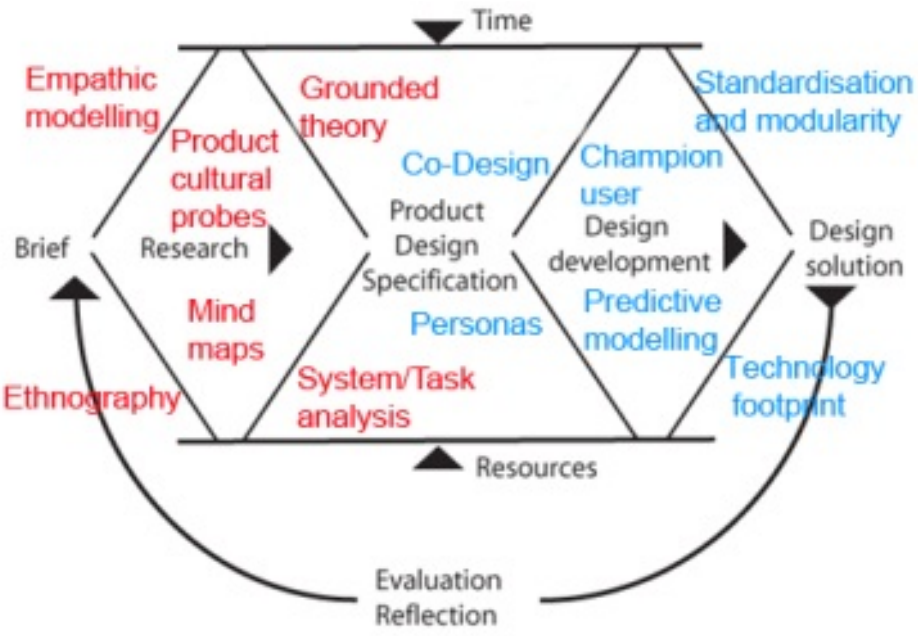


Figure 2: Shows the context for some of the methods used within the LAT-UD methodology.

5. Market characterisation

The methods and tools shown in Figure 2. have a natural grouping of those methods that collect information to inform decision-making (red) and those which help make design-decisions (blue). The methodology may be considered to fit within the category of a mixed methods approach as defined by Creswell (Creswell 2006, Creswell and Plano-Clark 2009). The starting point for any new product development is defining the need and characterising the market the range of individuals within it. Organisations such as National statistics offices

(National Statistics Office 2012) the World Health Organisation (WHO 2012) hold useful data relating to the numbers of people with impairment or who may be considered disabled. Once a market size has been established the choice of methods of manufacture may be narrowed.

For those unfamiliar with the AT market, the use of empathic modelling can provide insights into the issues faced by those with specific impairments, such as arthritis, partial sight or blindness. This form of modelling also helps a designer or NPD team ask the right questions of target or end users. Although simulation of impairments can be replicated by improvisation, there are simulations suits available such as the Second-skin system (Loughborough University 2012a), shown in Figure 3. Brainstorming is useful to help identify issues, which may then be placed within a context using a mind-map technique. An example of mind-mapping is shown in Figure 4.

Figure 3: Shows the Second Skin simulation suit (Loughborough University 2012a)

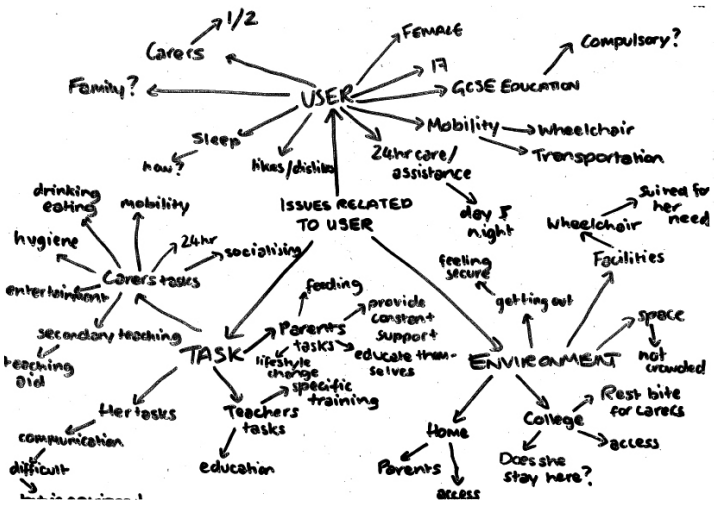


Figure 4: Shows an example of mind-mapping of a mobility product. (Torrens 2011)

Once a background literature review has been done, unanswered questions may be investigated using product cultural probes (see Figure 5.) and observation, for example, using ethnography, system or task analysis (Cohen et al 2007). More specific questions may be posed to samples of the target market or end users through questionnaires, interview, teleconferencing (Torrens 2011) or focus groups (Morgan 1997). The outcomes may be presented in a graphical format of web diagrams. An example of different viewpoints of end user and associated stakeholders involved with a paralympic sports product (shown in Figure 6.) may be presented in a way that enables a designer or NPD team to make informed design decisions towards an optimum comprise of requirements.

Figure 5: Shows an example of a set of product probes (Torrens 2011)

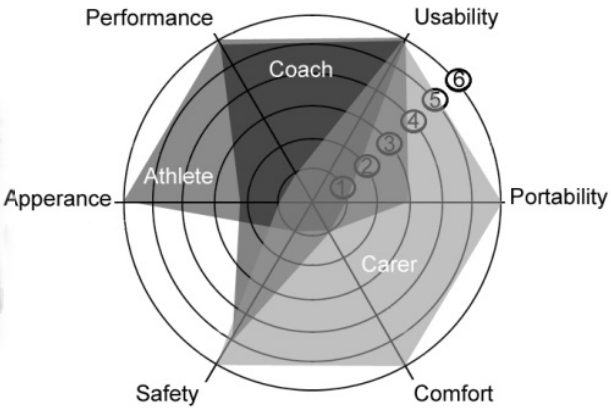


Figure 6: Shows an example of a web-diagram presenting the preferences of a paralympic athlete, coach and carer for an AT sports product. (Torrens and Black 2011)

6. Innovation: challenging convention

Using a grounded theory approach (Cohen 2007) a consensus for a product design specification (PDS) may be developed and further validated by the methods outlined. Once a PDS has been defined, innovation can be produced through challenging the conventions and

doctrines of the target market, end users and associated stakeholders. Challenging convention is only possible when the designer has good knowledge of the market and existing conventions. The end users and stakeholders can be explicitly presented through the use of personas and scenario of use. Three case studies will provide examples of these aspects.

The use of a champion user or users in conjunction with co-design (Kemp and van Geldren 1996) has been found by the author to reduce the time taken in decision-making relating to detailing and attribute priorities within a new product design development. (Torrens 2011) Whilst only one or a small number of end users or stakeholders, many of the imbalances in the PDS may be identified and resolved before undertaking more expensive validation with a larger group. This method is particularly useful when the market is very small and end users are difficult to access; for example, paralympic athletes.

When enough information or data has been collected about a target user group or stakeholders, the information can be collated to produce predictive modelling tools, such as SAMMIECAD and HADRIAN. SAMMIECAD (see Figure 7) is a software tool that enables a designer to define a target user for their product, check the anthropometric scale and physical accessibility of the product by the specified users. (Loughborough University 2012b). HADRIAN is a predictive tool within which an avatar may be given specific characteristics and impairments, (Porter et al 2004). The avatar is then asked to complete a specified task with a pre-defined computer generated product. The outcomes of task performance are predicted to enable a designer to keep the product and proposed method of use within the capabilities of the defined users. These design tools and others may be accessed through the AUNT-SUE website (Loughborough University 2012a).

Figure 7: Shows an example of a predicted and real usage of an ATM machine (Loughborough University 2012b)

Figure 8: Shows the AUNT-SUE website. Loughborough University 2012a)

7. User Centred Design: Technology Footprint Assessment

A design tool that has been found to be an effective method of refining AT product designs is Technology Footprint Assessment (TFA). This tool is based on David Marr's computational theory of vision perception (Marr 1982). Marr indicated that humans build up a visual map of the world from a series of visual scans, from a 2D outline through to a fully-rendered 3D environment. The TFA tool focuses on the initial scan made where we identify outlines, important to identifying visual elements that pose a threat, such as objects heading towards us or a Tiger hiding nearby, or that are food shapes (background to foreground differentiation).

When applied to AT products, the author has found in previous years that effective use of technologies has visually swamped the person using it. Figure 9. provides a worked example of a person using AT products where the design team have reduced the visual footprint over the body. (Torrens 2011) The author designed and made a baby

carrier for a mother with cerebral palsy, shown in Figure 10. The visual impact of the structure was minimised through the use of a single pole support thin rod holding structure and satin finish black frame. Using Marr's theory of perception, the viewer should define the outline of the proprietary baby carrier seat and mother before the supporting frame.

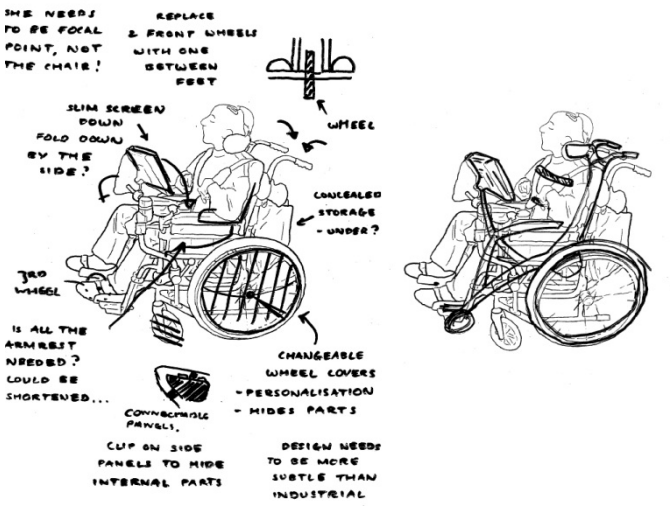


Figure 9. Shows a worked example of a person using AT products and how the TF may be reduced. Torrens 2011)

Figure 10. Shows an example of a wheelchair baby carrier designed and made by the author.

8. AT product viability: Expanding your market

A key element of the LAT-UCD methodology is the use of standardisation and modularity within the product's design for manufacture and assembly (DFMA). Standardising on original equipment manufacturer (OEM) parts for the core physical functional components of an AT product increases the potential viability of an AT product. Standard locations and assembly interfaces within the core

subassembly offer the greatest opportunity to attach a range of components that customise the product for a niche market. ‘plug and play’ technology within computer peripherals are a good example of this strategy. The author has successfully applied this design and manufacturing strategy to AT products. (Burkitt et al 1995, Torrens et al 1996).

9. Case studies

The following case studies provide exemplars of the application of the LAT-UCD methodology previously described. Three case studies each provide a snapshot of the methodology that highlights different aspects within it: A kitchen chopping board system for people with hemiplegia demonstrates a rigorous UCD approach; the design of a hearing aid for older men highlights the use of semantics to change the perception of society towards this AT product; and, a hand cycle for use with a range of different wheelchairs that demonstrates the potential for use in other markets.

9.1 Case study 1: A one handed kitchen chopping board system

The original need was identified by the designer (Rowan Williams) through family and friends. Literature review and background information on existing products was gathered that identified a gap in the market for a cutting/chopping board that was capable of being used one-handed. This was primarily aimed at those who had suffered a stroke and were living with hemiplegia. As the system developed, it became clear the product would provide a high-quality experience to any user through aesthetics and ease of use. The novel peg system has been patent registered.

The designer undertook iterative cycles of card, foam and other soft modelling in conjunction with their champion user. The product was then validated with Occupational Therapists and the aesthetic appeal with a wider range of the adults for whom this was targeted. A rigorous DFMA approach was applied to the detailing of the injection moulded parts, prototyped using rapid manufacturing techniques, which would only be viable to fund if the target market was expanded to include an able-bodied user group or consumer.

Figure 11: Shows a compilation of images of the Pego cutting board system which comprises of a working finished prototype. (Designer: Rowan Williams).

The original design had semantic cues of colour, edge detail and textures that linked with high-quality kitchenware currently on the UK market. The high quality of design detailing brought the PEGO system into the mainstream market. Since the launch of the design, the designer has had expressions of interest from UK high street retailers and is currently a finalist in the Design Innovations in Plastics Awards 2012 with this product.

Figure 12: Shows a scenario of use for the Pego cutting board system using both finished and prototype components. (Designer: Rowan Williams).

9.2 Case study 2: A hearing aid for older men

The SONAS audio system was originally developed to alleviate the stigma associated with older men wearing a hearing aid. The designer (Alex Roper) had identified this need through his grandfather, who suffered with Tinnitus, a form of constant ringing in the ears. As with the PEGO system, the designer produced a high quality aesthetic product that had a number of elements that enhanced the viability of the product. The system used a proprietary high-performance ear plug that is custom-fitted to an individual's ear by an audiologist. The standard OEM part matched with an external casing, which housed further OEM electronic parts. The designer validated that the scale and volume of the OEM electronic parts would fit within his outer casings. The proposed was system to be connected via Bluetooth to a base station, which also was the carry case for the earpieces, as shown in Figure 13.

Figure 13: Shows the finished appearance model of the SONAS mobile high quality sound system (Designer Alex Roper).

All items were validated for scale and usage with the target aged males. The standardised external casing connection enabled alternative modular options to be offered to the target user. (See Figures 14, 15 and 16). Figure 16 shows a comparison of proprietary earpieces with the SONAS. The new system has a more body-worn ornament or jewellery aesthetic, with associated visual cues, than those currently available.

The most important insight came from the designer's brainstorming of the Brand delivery were keywords not associated with any form of impairment or disability. This led to the deliberate decision to switch the focus of presentation from an AT product to a mainstream, high-value, audio product that could also be used as a hearing aid. The change in perspective is shown in the diagram in Figure 17. Changing the perception and cognitive framing of the product opened a much larger market. The product has already won a University sponsored enterprise award and has attracted interest from venture capitalists.

Figure 14: Shows a finished appearance prototype with fitted earpiece. (Designer Alex Roper)

Figure 15: Shows the modular options of colour and detail of the SONAS earpiece. (Designer: Alex Roper).

Figure 16: Shows a visual comparison between proprietary hearing aids and the SONAS (Designer: Alex Roper).

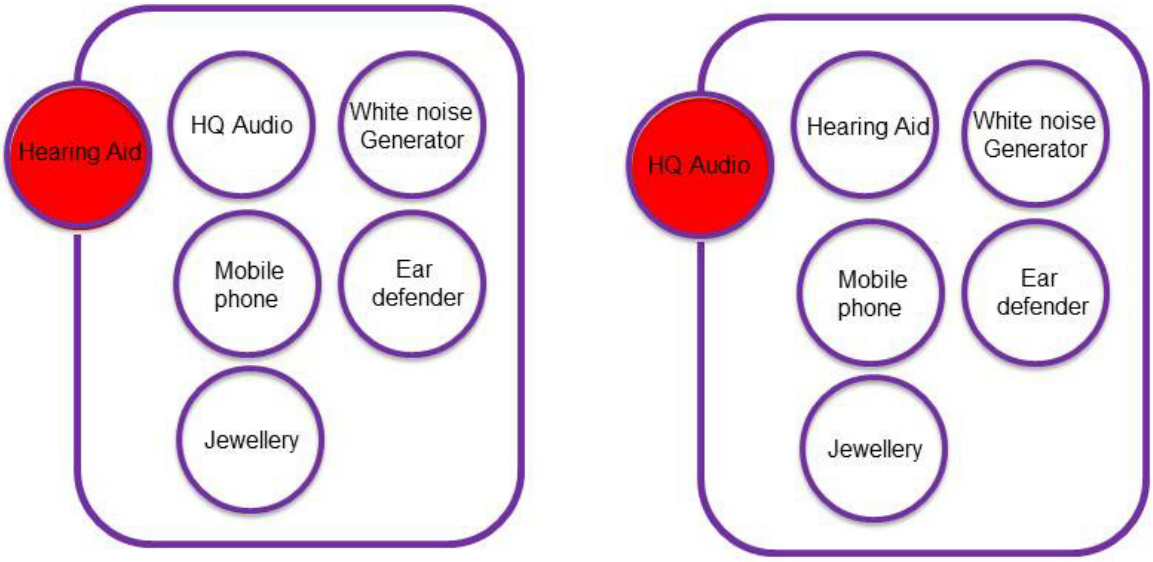


Figure 17: Demonstrates the change in perception from an AT product to an Inclusive/ Universal product through the manipulation of semantics and social values.

9.3 Case study 3: A hand cycle with a modular attachment to a range of wheelchairs

The Velo hand cycle (Figures 18 and 19) came from the University bursary placement experience of the designer (Mark Wafforne) as a researcher and designer. The designer had identified the need for an entry-level hand cycle for use in UK Schools and sports clubs that would attach to an existing wheelchair. UK sports clubs have to ensure they can accommodate all individuals who wish to take part in a sport; in this case, athletics and the equivalent wheelchair racing. The standardised system of adjustment enabled a custom attachment to be achieved with most makes of wheelchair. A similar standardised adjustment mechanism enabled the hand crank handles to be positioned optimally for different users. The novel enclosed composite belts provided a high quality visual to the design and offered some protection against dust ingress, tampering or misuse. This design is in

contrast with the majority of open metal-chain systems of hand cycles currently on the market.

Figure 18: Shows the Velo hand cycle system and attachment mechanism. (Designer: Mark Wafforne)

The designer followed a conventional physical and CAD-based prototyping strategy, using a mixed methods approach to validation, as it was difficult to gain access to wheelchair athletes and coaches on a regular basis to use then as a champion user. Feedback gained from one sports coach who was involved in setting up inclusive community sports internationally highlighted a large market that had previously not been considered. In many developing countries a hand cycle format for non-ambulant people is desirable, due to the rough terrain. A modular system, as proposed, could be attached to any back unit including a tricycle system with a bench and back-board for carrying goods.

Figure 19: Shows a conventional DFMA approach to a principle-proving prototype. (Designer: Mark Wafforne)

10. Conclusion

In conclusion, the case studies have demonstrated the expansion of viable markets may be achieved through changing perceptions and responses to an AT-focused product, using alterative words and visual forms to emphasise 'enhanced living' rather than 'assisted living'. The use of the LAT-UCD methodology can produce a commercially viable and desirable AT product. Each of the products discussed have taken a need and produced a high-quality solution. By taking the generic purpose of the product, which has been effectively satisfied, new markets may be identified that require a product that delivers the same purpose. The challenge facing AT product designers is to apply the methods described to their own practice and, within the current economic climate, take further small steps towards a more inclusive society.

11. References

Barnes, C., 1995. Disability rights: rhetoric and reality in the UK. Disability & Society, 10, (1). pp. 111-116.

Burkitt, J.A., Torrens, G.E., Kay, G.H., Sandbach D., and Sutherland, I.A., 1995. The development of the Autosip: A hygienic, self-operated, drinking device for people with minimal sucking ability and/or minimal arm strength. Journal of Rehabilitation Sciences, 8, (4). p 115.

Christophersen, J. and Norske stats husbank. 2002. Universal design: 17 ways of thinking and teaching. Husbanken, Oslo

Cohen, L., Mannion, L., and Morrison, K., 2007. Research methods in education. 6th ed., Routledge. London

Creswell, J.W., 2009. Research design: Qualitative, quantitative, and mixed methods approaches. 3rd ed. Sage, London.

Creswell, J.W. and Plano-Clark, V.L., 2006. Designing and conducting mixed methods research. Sage, London.

Fuhruer, M.J., Utai, J.W., Scherer, M.J., 2003. A framework for the conceptual modelling of assistive technology device outcomes, Disability and Rehabilitation, (25), 22, Informa PLC, London. pp1243-1251

Kemp , J.A.M., and van Geldren, T., 1996. Co-discovery exploring: An informal method for iteratively designing consumer product. Usability evaluation in industry, (eds.) Jordan, P.W., Tomas, B., Weerdmeester B.A., and McClelland. I. L., Taylor & Francis, London.

Loughborough University, 2012a. AUNT-SUE. (Available from: http://www.aunt-sue.info/), [accessed: 24/06/2012]

Loughborough University, 2012b. SAMMIE CAD, (Available at: http://www.lboro.ac.uk/departments/cd/research/groups/erg/sammie/home.htm), [accessed: 24/06/2012)

Marr, D. 1982. Vision: A computational investigation into the human representation and processing of visual information MIT Press.

Morgan, David L. 1997. Focus groups as qualitative research. Qualitative research methods series. 2nd ed. 16. Sage London.

National Statistics Office. 2012 National Statistics Office (Available from: http://www.neighbourhood.statistics.gov.uk/HTMLDocs/dvc5 /agemap.html), [accessed: 24/06/2012]

Porter, J. M., Case , K., Marshall, R., Gyi, D., and Oliver-Sims, R., 2004. Beyond Jack and Jill: Designing for individuals using HADRIAN. International Journal of Industrial Ergonomics 33, (3), Elsevier, London. pp249-64.

Philips, B., 1993. Predictors of Assistive Technology Abandonment, Assistive Technology: The official journal of RESNA, (5), 1. Taylor and Francis, New York.

Torrens, G. E. 2000. The implementation of a user-centred design approach by student industrial designers when designing for elderly and disabled people. The Design Journal 3, (1). Berg, London. pp 15-30.

Torrens, G.E., 2011. Universal Design: empathy and affinity, Chapter 16, In. Handbook of Human Factors and Ergonomics in Consumer Products, (Ed), Karwowski, W., Soares, M., Stanton, N.A., Taylor & Francis, London. pp233-248

Torrens, G.E., and Black, K., 2011. Chapter 5, Equipment design in Inclusive physical activity and disability sport, In. Design for sport, (eds) Roibas, A.C., Stamatakis, E., Black, K., (Available from: https://dspace.lboro.ac.uk/dspace-jspui/handle/2134/9025), [accessed: 24/06/2012] Gower Press, London.

Torrens, G. E., Marshall, R., Burkitt, J., and Kay. G., 1996. Using modularity to produce more competitive assistive technology products. IMC-13 Annual Conference of the Irish Manufacturing Committee, University of Limerick, Limerick.

World Health Organisation, 2012. WHO, (available from: www.who.int/en), [accessed: 24/06/2012]

Announcements

1. We are pleased to announce that the application process is open for the 2013 Stanford-India Biodesign (SIB) Fellowship. The goal of this programme, launched in 2007, is to train the next generation of biomedical technology innovators in India. This highly competitive programme is directed to Indian citizens who have an interest in the invention and early-stage development of new biomedical technologies.

The SIB Fellowship Programme is centred at Stanford and in New Delhi and administered as a collaboration between Stanford University, the Indian Institute of Technology Delhi, and the All India Institute of Medical Sciences (AIIMS) in partnership with the Indo-US Science & Technology Forum (IUSSTF).

Fellows receive tuition, stipend support, and international travel arrangements. Over the course of the 1 year fellowship, approximately half of the fellows' time will be spent at Stanford University and the other half in India. Fellows work on a multidisciplinary team joining other innovators with a combination of engineering, medical and business backgrounds. Preference will be given to applicants with significant work experience. The fellowship application deadline is May 18th, 2012. Select applicants will be interviewed in Delhi. The fellowship starts at Stanford in January 2013. A detailed programme description and fellowship application are available at the Stanford Biodesign Programme website:

http://biodesign.stanford.edu/bdn/india

For further programme details, please contact info@sibiodesign.org

Christine Kurihara: Manager, Special Projects

Associate Director, Global Programs

Stanford Biodesign Program

http://biodesign.stanford.edu/

sibiodesign5 mailing list

sibiodesign5@lists.stanford.edu

https://mailman.stanford.edu/mailman/listinfo/sibiodesign5

Appeal

Ali Yavar Jung National Institute for the Hearing Handicapped, (AYJNIHH) Mumbai, in collaboration with Department of Communication (DCJ), University of Mumbai offers one-year Post Graduate Diploma Course in Media & Disability Communication, (PGDMDC), specializing in 'Accessible Media Programs and Universal Design' for careers in the Mass Media industry.

During the one-year course the students can learn to make various types of accessible media programs and products. They will have 'hands on' experience in making short films in accessible format and learn how to increase the market of the digital media, through multi-language captioning, audio-description, Indian Sign Language (ISL) and accessible website creation etc.

This training program will implement the guidelines of the United Nations Convention, on the Rights of Persons with Disabilities (UNCRPD) vide article 8 on 'awareness raising', article 9 on 'accessibility' and article 21 on 'access to information'. This is the first organized effort in India, to create a cadre of Mass Media Students and Professionals to address disability issues and create accessible media programs.

The advent of digital telecast in the four metros in the country, will enable implementation of accessible media programs possible to the media houses for the benefit of viewers and increase target audience. The first batch of students, who have completed the course have been employed successfully.

Eligibility : Diploma or a Degree in Journalism/Communication or Public Relations course with 50% marks. Candidates who have appeared for their final examinations can also apply.

Last date for submission of application has been extended to 27th July 2012. For course details contact: +91-22-2640-9465/ 98-6999-3833. P.J.Mathew Martin, www.ayjnihh.nic.in

Program and Events

1. Aging in Society: An Interdisciplinary Conference

The 2012 Aging Conference will take place at the UBC Robson Square, Vancouver, Canada from 5-6 November. www.Aging-Conference.com If you intend to present a paper at the conference, your participation begins with submission of a paper proposal. For information on proposals, presentation types, and other options, please see our website. To submit a proposal, please click here. If your proposal is accepted, you will then need to register for the Conference. Those who submit paper proposals should register following the acceptance of the proposal. Conference delegates who do not intend to present may register at any time. For registration options, or to register for the 2012 Aging Conference, see: http://agingandsociety.com/conference-2012/register/.

2. HInternational 2013

HCI International 2013 21 - 26 July 2013, Mirage Hotel, Las Vegas, Nevada, USA. The conference objective is to provide an international forum for the dissemination and exchange of up-to-date scientific information on theoretical, generic and applied areas of Human-Computer Interaction (HCI), Universal Access, Engineering Psychology, Cognitive Ergonomics, Virtual and Mixed Reality, Internationalization, Design and Global Development, Online Communities, Social Computing, Augmented Cognition, Digital Human Modeling, Human Centred Design, and Design, User Experience and Usability. This is accomplished through various modes of communication, such as plenary presentations, parallel sessions, poster sessions, tutorials, exhibitions, etc. http://www.hcii2013.org/index.php

3. 8th International Short Break Association 2012 (Respite Conference), 10-12 October 2012, Toronto.

Short Break care, known more as respite care in Canada and the United States, is a critical element of support for families who are caring for individuals with disabilities or ongoing disabling conditions. The theme of the conference therefore, is "Respite is Key" http://www.isba2012.net We will spend time focusing on four themes:

- Opening the Door to the Community: Respite/short break care as a means to assisting people to have an opportunity to have a full life in the community.
- The Key to Strengthening Families: Models for flexible, individualized respite/short break programs around the world, research and family input.
- Unlocking Resources: How are countries managing to provide resources in times of economic restraints, how do families manage with limited resources and how do we combine paid and natural supports.
- Treasures Found: The goal with respite /short break care is to focus on developing relationships- how do we encourage this, how do we ensure the right people are in place, how do we minimize risk.

4. HWID 2012 Working Conference on Work Analysis and HCI

The HUMAN WORK INTERACTION DESIGN 2012 (HWID 2012) working conference analyzes the combination of empirical Work Analysis and Human computer interaction (HCI). We very much look forward to welcoming you to Copenhagen! The Scandinavian countries have for

many decades been very active and influential in the international HCI community by shifting research focus to empirical studies of the application domains and contexts of ICT, such as work and leisure, private and public domains. Although this is well known, much work analysis approaches does not include HCI design and much CHI research and development does not include work analysis. Focus is on either work analysis or HCI design/evaluation, although both approaches are seriously needed for the development of successful ICT applications. The HUMAN WORK INTERACTION DESIGN 2012 (HWID 2012) working conference analyzes the relation of Empirical Work Analysis and Human Computer Interaction (HCI). We encourage a dialogue between HCI and Work Analysis approaches. HWID 2012 will take place in December 5-6, 2012, in Copenhagen Business School (CBS), Denmark. https://sites.google.com/site/hwid2012/

5. DesigNation8: DesignPower!

DesigNation® is the largest gathering of designers of colour in the world and the first multidisciplinary design conference in the world! DesigNation8: DesignPower! will bring together some of the world's top designers to explore how the power of design impacts and influences the local, national and global economies and national and global cultures. And to showcase and share their work. This is our 8th international design conference. The conference attracts established and emerging designers, educators and students. With members and affiliates nationally and internationally, DesigNation8: DesignPower! reflects the mission of OBD of inclusion and diversity. Sponsors: Procter & Gamble, GM, Nike, Herman Miller, Steelcase, BET, Haworth, Adobe, Ford, Chrysler. Visit http://www.obd.org or email: DesigNationConferences@gmail.com

6. Transed 2012

Svayam, an initiative of S.J.Charitable Trust, India is proud to announce that the 13th International Conference on Mobility and Transport for Elderly and Disabled Persons (TRANSED 2012) will take place in India from September 17-21, 2012. The Theme of TRANSED 2012 is "Seamless access for all: Universal Design in Transport systems and built infrastructure, a key element in the creation of livable cities." Sub Themes include: Role of the UN Convention on the Rights of Persons with Disabilities (UNCRPD), Best Practices and Innovations, Accessible Tourism: Conservation, Access to the Historic and Natural Heritage, Environmental Impact, Sustainability, and Accessibility of Integrated Multi-modal Systems, Accessible Public Transport (Bus Rapid Transit, Metro, Para-transit systems etc.), Highway Design and Safety, Pedestrian Mobility & Safety for Livable Communities, Rural Access and Mobility, Implementation, monitoring and enforcement, Potential of Technology in Accessibility for All (Information Technology, Accessibility Aids etc.), and others.

7. Health 2.0 Europe

Since 2007, the Health 2.0 Conference has been the leading showcase of cutting-edge innovation transforming the health care system. Not your typical stodgy conference, Health 2.0 brings a fresh approach to the space and is the leader in health care technology today. We bring together the best minds, resources and technology for compelling panels, discussions and product demonstrations. In addition to our flagship event held in San Francisco each fall, we also host an annual

"Spring Fling" event and multiple international conferences, including Paris, India and Berlin. http://www.health2con.com/events/

8. Taiwan International Design Competition

The Taiwan International Design Competition (TIDC) is entering its ninth consecutive year. In the nine years of its existence it has already cultivated an extensive international reputation. In addition to encouraging more imaginative and innovative creations, it also hopes to use current trends to inspire designers to engage in more profound philosophical and humanistic reflection. This will allow designers to not just be confined to an 'object' itself, but to incorporate a return to life's subtleties of life in design concepts.

Theme: Maximinimization - Design is a kind of magic from the heart of the designers. Observing the subtle psyche of consumers, and giving expression to their needs in products – such is what design is! Designer brings an enormous amount of creativity with carefulness. This is just like people from the Orient who use the smallest seal to make their greatest commitment with their heart. Likewise, simple and easy steps are employed to complete a complex and difficult operation, employing minimum resources to create maximum effect. http://tidc.boco.com.tw/2012/en_page03-1.html

9. 4th International Conference on Research into Design ICoRD'13

ICoRD'13 is the fourth in a series of conferences intended to be held every two years in India to bring together the international community from diverse areas of design practice, teaching and research, to: showcase cutting edge research about design to the stakeholders; aid the ongoing process of developing and extending the collective vision through emerging research challenges and questions; and provide a

platform for interaction, collaboration and development of the community in order for it to take up the challenges to realize the vision. The conference is intended for all stakeholders of design, and in particular for its practitioners, researchers, teachers and students. The theme for ICoRD'13 is Global Product Development. The conference is an endorsed event of the Design Society

• Invited/keynote presentations from eminent international experts and practitioners;

• Presentations of refereed papers as podium, poster, panel or theme presentations;

• Industrial sessions to present perspectives from industry and studies in practice.

10. International Workshop: Human Rights of Older Persons in Asia Pacific Region Focus on Health and Wellbeing.

The International Federation on Ageing in partnership with the Centre for Gerontological Studies in Thiruvananthapuram, India, are proud to announce an International Workshop on Human Rights of Older People

in the Asia-Pacific Region with a special focus on health and wellbeing.

India accounts for 2nd largest population of older people in the region and in the world and has the 2nd largest democracy in the world. It has a well-established human rights system and a sound elder empowerment programme through its National Policy on Older Persons. The aim of this event is to explore the status of the rights of older persons in the context of existing regional and international instruments.

Workshop objectives

To examine areas where the rights of older people are especially known to be vulnerable, e.g. social insurance including economic security, health security and family security

To determine the nature and extent of gaps in protecting the rights of older people in the region

To focus on the special conditions of marginalized groups - older people with disabilities, those who are in the oldest old age groups, older people who are dependent

To raise awareness on the evolving machineries at country and regional level for implementation and monitoring of the recommendation of the Workshop and liaising with UN bodies

To register please contact Ms. Allison Gorman at agorman@ifa-fiv.org at the IFA, or Dr. Nayar, at the Center for Gerontological Studies, pkbnayar@rediffmail.com.

Please note the workshop is FREE of charge and space is limited.

11. International Istanbul Initiative on Ageing 2013

Under the auspices of the International Federation on Ageing (IFA) in partnership with Turyak Seniors Council Association, we are proud to announce the International Istanbul Initiative on Ageing (IIIA), on October 4-6, 2013 in Istanbul, Turkey at the WOW Hotel and CNR Convention Center.

This initiative aims to explore opportunities and innovative ideas as population ageing progresses specifically in the regions of the Middle East, Northern Africa and Eastern Europe. http://www.ifa-fiv.org/

The 2012 International Universal Design for Learning (UDL) Conference: Innovation in Education and Language Learning

The 2012 UDL Conference provides a venue for international collaboration, innovation in 21st century education, as well as thinking about the latest information in research, policy and educational practice with a special focus on the ways that UDL can be used to support teaching- learning Portuguese in the communities around the world. This conference also provides an inclusive and dynamic forum for educators and others to network and share information in a variety of sessions, workshops and poster presentations that will benefit learners everywhere.

The keynote-speaker for the conference will be the UDL pioneer Dr. David Rose a distinguished American neuro-psychologist, and a prominent researcher who teaches at Harvard's Graduate School of Education where he has been on the faculty for more than 25 years. In 1984, Dr. Rose co-founded CAST.org, a not-for-profit research and development national organization located in Wakefield, Massachusetts. CAST.org is the birthplace of Universal Design for Learning (UDL).

Universal Design for Learning or UDL is a powerful, innovative, evidence-based framework that provides educators with effective tools

and blueprints that provide all individuals equal opportunities to learn (at any level of education). UDL is recognized at the highest levels of education in the USA including the White House and it is having a profound impact on teaching & learning. In addition, UDL is now influencing educational policy and practice throughout the United States and beyond from Pre-K to University Levels.

This initiative is sponsored by the Government of the Azores (Portugal) in collaboration with CAST.org (United States), the Portuguese World Language Institute at Lesley University (United States) and the University of the Azores (Portugal). The conference will be held in Ponta Delgada, Azores, Portugal on September 6 and 7, 2012.

https://sites.google.com/site/2012udlinternationalconference/

Job Openings

1. TI Cycles

TI Cycles is looking for graphics designer who can be part of design team at Chennai. Pl go through the details below, interested can forward their resume and portfolio of work to sangewarr@tii.murugappa.com / TI Cycles has been at the forefront of personal mobility solutions for over 6 decades and has gone from being a pioneer in bicycle design and manufacture to a complete mobility and well-being expert. Standing for the core promise of fun, fitness and freedom, TI Cycles offers consumers a range of bicycles, e-scooters, fitness equipment and infant mobility solutions.

Position: Graphics Designer

Type: Full time - Permanent

Job Responsibility:

- To lead the product graphics design solutions for all products across businesses.
- Color palate and graphics guidelines based on brand positioning and consumer segmentation
- Color trend tracking
- Take ownership of releasing/archiving of artworks
- Sign off on all final graphics/color samples as per guidelines
- Graphical User Interface design support
- Salary: should not be a constraint
- Educational qualifications Bachelors or Masters in Graphics Design/Visual communication or equivalent from NID, IIT etc. Relevant experience 2-3 yrs. of experience preferably in product design graphics Threshold skills and capabilities Passion for design and sense for balance and out of the box graphics and illustration skills
- Good ability to communicate the ideas visually and verbally
- High Proficiency in Adobe Photoshop, Illustrator and Corel Draw is a must Technical knowhow of print media and techniques for Product graphics

2. Paper Plane Solutions

Paper Plane Solutions is on the lookout for a PHP Developer. Paper Plane is committed to building world-class digital products and experiences in an environment where engineers love to work. We have a spectacular Engineering team focused on solving complex problems. Our engineers work on fulfilling, self-directed projects and are actively

encouraged to participate in open-source projects. We are a 12+ year-old Web Solutions company with a very strong web presence, determined to stay ahead of the curve and by doing so, remain relevant and maintain growth. Our development team is small, tight and every member supports the other where relevant. We find this expands the broad set of skills the team possesses. Please send in your Cvs to rajalakshmi@paperplane.net

Job Location: Kala Khoda, Fort – Mumbai

What we need?

- We need an experienced web developer to join our team and extend our development boundaries
- You should have at least 3 years high-value experience developing dynamic websites and kick ass interactions
- We are looking for extraordinary talent, engineers who share similar values and who will feel comfortable joining our small family
- This is a full-time position with a competitive salary and a lot of fun.
- Please don't apply if you are a recruiter, freelancer or unwilling to work in Aamchi Mumbai.
- URLs and self-written sample code strongly preferred

The Challenge/Excitement/Fun

- Are you the sort of guys that gets off writing high quality code, building great web products working with new technologies, functionality, and experiences with a consistent focus on quality, scalability and performance.
- Can you constantly improve production, code quality and delivery techniques?
- Are you a passionate individual who enjoys testing your skills while at the same time, seek to live a balanced and happy life?
- Are you confident of your programming fundamentals?
- Can you understand client requirements and create task flows based on those?
- Are you a wizard at commanding browsers to display information in a highly usable, informative fashion?
- Do people seek your advice when writing AJAX code, using jquery or other javascript libraries?
- Do you research and embrace newer technologies such as Ruby on Rails, Groovy/Grails and/or Python/Django or Open Source CMS?
- Can you take XML/JSON data and work miracles with it?

- Can you run a workshop on the pros and cons of using PHP and the various MVC frameworks?
- Are you tired of mediocrity and are eager to break free?

If your answers are predominantly “Yes”, it shows that you are a person who CAN-DO! You will thrive in the Paper Plane environment and we encourage you to read on!

- Hands On Requirements:
- Deep roots in Object Oriented and MVC programming
- Backend - PHP/MySQL/Code Ignitor
- Front End – Javascript, Ajax, JQuery
- Clean, Optimized Indented code
- Strong understanding of DOM, HTML CSS, semantic markup, and cross-browser issues
- Excellent analytical and troubleshooting skills
- Helpful to know LAMP, PHP, and/or MySQL
- Fearless ability to jump lower in the stack to solve important problems
- Expert ability to get things done!

Other Qualities:

- Ability to work in an environment of perfection and compliance to web standards and high design quality benchmarks
- Strong organizational and time management skills – know what you need to do, and DO IT!
- Quality and hygiene of code will be a strong consideration
- Demonstrable communication skills (written and verbal)
- Collaborative style

You deserve a few more brownies or happy hours if you are experienced in:

- Mobile Development
- Experience with Open Source CMS Drupal, Wordpress, Cake, Zend
- Third party API integration like FB, Twitter, Sound Cloud
- Experience with other Server Side technologies like JSP, asp.net etc.

3. Logitech

There is an urgent opening at Logitech, Chennai for a User Interface Developer. Logitech is a product company and working here is just AWESOME! If you are interested in working on tangible interaction

design then this the right place for you! If you are a grad/Post grad with an attitude to solve complex problems with your creativity then, give it a shot. We are looking for a 4+ years of experience in UI development. If you have the right talent, experience would not be a barrier ;) Find the Job Description below.

Mandatory Skills:

- HTML 5, CSS 3, Silverlight, JQuery(Highly Preferred), One scripting language experience(VBScript or Javascript) and also good exposure to .Net Framework

Essential Technical Specification:

- One–two years of experience developing user interfaces for iPhone applications
- Expertise with iPhone application development standards and trends
- Knowledge of Apple's Human Interface Guidelines for Mac and iPhone
- Ability to turn wireframe specifications into working prototypes
- Ability to turn low fidelity prototypes into high-fidelity prototypes
- Ability to create Flash prototypes of interactive applications
- Experience working within a collaborative team environment.
- Advanced problem solving, coding, and debugging skills
- Portfolio of past work

Behavioral Competencies & Values:

- Effective spoken & written communication skills, proactive, and a good team player.
- We are also looking for Interns for Logitech's Data Content Group, who can analyse the data and come up with strategic solutions. I believe this is a great opportunity for students who are looking forward for the role of Business Analysts.

4. Neointeraction

We are looking for a freelancer Html developer with good HTML5, J-query skills to work for a 2 - 3 months assignment @ Bangalore. This is an immediate requirement and it strictly requires working from our client's location. If anyone interested please drop a mail to sam@neointeraction.com / Tel : +91-944 9565 744 / +91-80 4095 3785

5. Tarnea

We are looking for a visual designer to join the UX team at Tarnea. Experience in designing layouts, icons, and other visual assets for mobile and tablet based applications. About Tarnea:

Tarnea is a technology startup based in Bangalore working for the global markets. It has been set up by professionals from the IT industry. The founders have held leadership positions in leading Indian and multinational companies for over 20 years. The company is developing innovative products and solutions. Our products and solutions are at a confluence of - Mobile Computing, Social Media, Cloud based infrastructure, Harnessing real-time intelligence from information. This is a unique opportunity to not only work at the cutting edge of technology but to fundamentally challenge and rewrite some of the rules of the IT business. Tarnea's espouses a strong Engineering culture and our approach is centred on Design Thinking inspired and popularized by Ideo. Every product or solution is a Design Intervention to improve the status quo – we don't deliver "code against specs" or offer "bodies on hire". Team Tarnea spends much time "out of the building" to deeply connect with the eco-system in which our solutions work. In the recent past we have driven with truckers on highways, worked as store assistants, interviewed customers, farmers, wholesalers, retailers etc. before writing the first line of code. If interested kindly send your portfolio link or upload work samples on Google Drive or DropBox and send me a link.

Please do not attach your portfolio in the mail. In case you need more information, feel free to call me on my cell.

Email : sanjay.raval[at]tarnea.com /

Phone : +91 - 94488.46428

6. Visual Designer

We are looking for talented visual designer to join our User experience team at Bangalore. Experience in designing icons, and other visual assets for web based and desktop applications is required. Detailed detailed Job description, and Apply online.

http://careers.informatica.com/job/Bangalore-Senior-Visual-Designer-Job/1935123

7. Mudpie

MudPie, a young, vibrant brand communication and design firm in Gurgaon handling a host of national and international brands is looking for:

- Art Director : 4-6 years of advertising/graphic design experience in an advertising or design firm. Able to handle a team independently. Be able to take on brand identities, advertising campaigns, packaging. Impressive folio and fluency in software is a must. Location : Gurgaon // Position : Full time & immediate // Salary : At par with the best

- Visualizer : 1-3 years of advertising/graphic design experience in an advertising or design firm. Experience in brand campaigns, identities and packaging. Fluency in software. Location : Gurgaon // Position : Full time & immediate // Salary : At par with the best

You can read more about MudPie at www.mudpieindia.com and see some of our work at www.mudpieindia.blogspot.com If you're interested, please apply with resume and work folio (samples of work is mandatory) to: start@mudpieindia.com

8. McKinsey & Company

UI Designer/Front-End Web Developer

Unit: Application Development Reports to: Team Leader – Application Development Team – GUR Location: Gurgaon, India

McKinsey & Company is one of the world's premiere management consulting firms with some 8,500 consultants across 89 locations in 50 countries. The Firm provides a full spectrum of consulting services primarily to large corporations but also to governments, international institutions, and non-profit organizations. These organizations include 100 of the top 150 global companies, touching every major industry. Application Development is an entity within McKinsey's worldwide IT organization with presence in New York and Gurgaon. The group serves the Firm's application development needs globally with three service lines: Application Development, Engagement Application Services and a Survey Design Center.

McKinsey's Application Development group builds web sites and other IT applications that support our global network of management consultants. Our goal is to provide McKinsey's business thought leaders the tools and knowledge they need as they work with clients around the globe.

Despite being part of a large, multinational organization, our group works more like a small startup company. Our development teams are small, flexible and employ agile methodologies to quickly provide our consultants with the solutions they need. We combine the latest open source technologies together with traditional Enterprise software products. Our office culture is casual, fun and social, with an emphasis on education and innovation. We have the freedom to try new ideas, experiment and are expected to be constantly learning and growing. There is also a strong emphasis on mentoring others in the group, enabling them to grow and learn also.

The UI Designer/Front-end web developer not only has a keen eye and sense of style, but also has the hands on skills to bring their visual art to life, through code. Well qualified candidates will have a generalist background with knowledge of web user interface design and front-end development. They will have a true passion for creative visual design, and have detailed knowledge of current user experience trends and information architecture in a web context. Excellent HTML, CSS and Photoshop (or equivalent), are necessary skills to have; while being able to work with Javascript, and jQuery are definitely a plus! An ideal candidate will also have mobile experience, as well as, have worked with HTML5 and CSS3. Please send your resumes to minal_verma@mckinsey.com OR kanchan_khera@mckinsey.com

9. Teamdecode Software Private Limited

We have an opening for Web and Visual Designers for those who are passionate towards their work, love what they do in a Company which provides full employee empowerment and working flexibility.

1 Opening

Experience: 2 - 4 Years

Location: Delhi, Delhi/NCR, Noida

Compensation: Industry best (dependent on experience and skills)

Education: UG - Any Graduate - Any Specialization, Graduation Not Required

PG - Any PG Course - Any Specialization, Post Graduation Not Required

Industry Type: IT-Software/ Software Services

Role: Graphic/Web Designer

Functional Area: E-Commerce, Internet Technologies

Desired Candidate Profile:

1. Strong visualization skills and conceptualization skills while designing user interfaces

2. Passionate about creative solutions and should be a natural problem solver

3. Hands on experience in writing table and table-less HTML

4. Working knowledge of CSS

5. Hands on experience in designing tools like Photoshop, Corel Draw, Visual Studio

6. Knowledge of flash will be an added advantage

7. Experience in designing applications for iPhone or Android platform would be an added advantage.

8. Good communication and analytical skills

Contact Details

Company Name: Teamdecode Software Pvt. Ltd

Website: http://www.teamdecode.com

Executive Name: Neha Tyagi

Address: Teamdecode Software Pvt. Ltd

A-139, Ground Floor, Sector-63

NOIDA,Uttar Pradesh,India 201307

Email Address: hr@teamdecode.com

Telephone: 0120-4571608

10. Senior User Experience Architect

Send your resume with a link to your online portfolio to kunal.pimplikar@fiserv.com

Position 1: Sr. User Experience Architect:

Industry Experience: 7 to 10 years

A Sr. UX Architect will be required to perform a strategic role along with occasional project specific roles. Responsibilities:

Strategic-

- Work with product owners to define the UX strategy and roadmap for individual business unit.
- Work towards developing capabilities within the UX_CoE Oversee various engagements within UX_CoE
- Project Specific-
- Work with Business analysts, product management, software developers to produce a world class user experience for Fiserv products.
  Translate high level business requirements into tangible user interface proposals that integrate the latest standards in interaction design and trends in visual design
- Create low-fidelity and high-fidelity task flow mock-ups and prototypes while integrating feedback from the product teams and our end-users
  Influence and educate the product teams in user-centred design principles and development processes
- Help define standards and best practices for consistent user experiences across Fiserv products

Position 2: Lead Usability Analyst / Usability Analyst

Industry experience: 3 to 6 years

Responsibilities:

- Work with Business analysts, product management, software developers to produce a world class user experience for Fiserv products.
  Translate high level business requirements into tangible user interface proposals that integrate the latest standards in interaction design and trends in visual design
- Create low-fidelity and high-fidelity task flow mock-ups and prototypes while integrating feedback from the product teams and our end-users
  Develop detailed interaction and visual design specifications and work closely with the development teams to implement them
  Influence and educate the product teams in user-centred design principles and development processes
- Help define standards and best practices for consistent user experiences across Fiserv products

*Skills (for both positions):

- Formal education in Human computer interaction design, Industrial design, Communication design from reputed institutes like IDC, NID or similar
- Strong conceptual skills and demonstrated ability to rapidly prototype and design
- Must demonstrate strong interaction design skills and have a solid understanding of usability principles and user centered design process
- Experience with working on various mobile platforms (iOS, Andriod, Windows Phone 7, etc) will be an added advantage
- Good understanding of user interface technologies (HTML/CSS, Silverlight, Flex,etc)
- Ability to work independently and prioritize and manage work to meet project timelines
- Must have an eye for detail and be able to quickly put ideas into a tangible form
- Has internalized a rigorous design process and is able to tailor it to the needs of different types of projects
- Must have a good understanding of visual design and hands on visual design skills is a plus
- Must have extensive experience working closely with development teams on implementation of designs

Contact Us

Free Registration to Design for All:
subscribe@designforall.in

Write to us about change of email address:
address@designforall.in

Advertising:
To advertise in digital Newsletter
advertisement@designforall.in

News and Views:
New products, events, seminars, conferences or workshops
News@designforall.in

Feedback:
Readers are requested to express their views about our newsletter to the Editor
Feedback@designforall.in

Acceptance of advertisement does not mean our endorsement of the products or services by the Design for All Institute of India

The views expressed in the signed articles do not necessarily reflect the official views of the Design for All Institute of India.

Address for Correspondence: 13, Lodhi Institutional Area, Lodhi Road, New Delhi-110 003India.

This Newsletter is published monthly,
by Design for All Institute of India,
3 Lodhi Institutional Area,
Lodhi Road,
New Delhi-110 003 (INDIA)
Tel: +91-11-27853470

E-Mail: newsletter@designforall.in
Website: www.designforall.in