

Ergonomics and Design for All

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Design for All/Universal Design is a holistic design approach that can be applied to communication systems, environments, public services, architecture and fast-moving consumer goods, so that each environment/product can be used by as broad a range of population as possible. "Usability" offers possibilities for taking full advantage of good products, buildings, environments and services to answer diverse needs. Design for All approach marks the transition to a fully inclusive concept of design actions, aimed at ensuring the effective wellbeing of people regardless of their level of ability, cultural background and preferences, as well as a pleasant experience. It identifies a person-centered design, that includes also the unexpressed needs, as well as their expectations.

This paper discusses the differences between "one size fits all" and "design for all", provides examples of a Design for All approach and how ergonomics can contribute to this approach.

Keywords: up to 5 Design for All, Universal Design, diversity, compatibility, community integration

1. Introduction

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A design approach for the configuration of spaces, objects and processes, which aims to be person-centered, cannot ignore the issue of human biodiversity and in particular, disability.

Each one of us is different from another human being, and is also different from himself during the course of life for physiological reasons such as growth and aging, but also due to temporary sickness or traumatic events, and to changes in preferences and opinions.

Of the disciplines that place the human being at the center of their interest, ergonomics is the one that pursues compatibility between the world around us, such as objects, services, areas of life and work, and psychophysical and social needs. The goal is to improve efficiency and reliability of systems, in a state of comfort, testing them with people's activities, carried out with a physical effort that does not exceed human thresholds. The latter can be very different depending on the individuals and the periods of reference.

In order to achieve comfort when interacting with the surrounding built environment, it is necessary to refer to very different skills, needs, preferences and cultural backgrounds than the traditional statistical and anthropometric references usually used by designers and ergonomists. One approach is Design for All / Universal Design. The aim of this paper is to explore the relationship between Ergonomics and Design for All, with some examples in different environments and sectors.

1.1 Accessibility and Design for All

Chapter edited by Isabella Tiziana Steffan, Studio Steffan-Design and Research, Milano, ITALY

The issue of disability is related to the accessibility of places and the usability of products, and has its roots in the design for specific categories of persons; among these, the design for special needs. It refers to people with special needs, that is, people with often severely reduced physical, sensory, cognitive abilities, and to the design of products and environments that can be used by them, not necessarily independently.

This approach includes personal care aids (e.g. prostheses, dedicated tools and aids, specific clothing), products for the environment (e.g. furniture, toileting aids and special handles), mobility products (e.g. wheelchairs, walkers, canes), modified products for individual needs (e.g. board games for children with severe disabilities), work products (e.g. technologies dedicated to individual categories of users such as speech synthesizers) and dedicated or protected environments (e.g. nursing homes, nurseries, laboratories, playgrounds).

Barrier free design, the design for the elimination of architectural barriers in public and private environments, is a reference for all national and international technical standards on accessibility. It aims to design environments and products that are usable by persons with reduced physical, sensory, cognitive abilities, while trying to ensure autonomy and participation in social life.

Often those involved in the processes of habitat transformation use the average-healthy-adult as a reference rather than people with disabilities. When the needs of the disabled are neglected during the stages of design, implementation and verification, this can produce "dedicated-usability" environments and equipment which suit individual user profiles but which are an obstacle to the social integration of the recipient.

Design for All, whose contents are similar to Universal Design and Inclusive Design, triggers a paradigm shift. It is a design approach that aims for a person-centered design, but not to a specific person (e.g. a child with severe disabilities), category of persons (e.g. people with limited mobility, visually impaired, obese), the elimination of a problem (e.g. manual or cognitive difficulties) or an obstacle (i.e. steps), but a design for the construction of an environment or product that takes into account individual needs, but which is compatible with as many people as possible. It is not only about meeting basic needs, or ensuring a task can be performed, but about making the built environment and the services enjoyable and accessible, and allowing full autonomy.

Such an approach is based on a framework of needs that includes the most diverse needs of users as well as unexpressed needs of users that are not always considered (e.g. those of people with cognitive disabilities, children, immigrants, disadvantaged). By taking as a reference the real person, makes up for the deficiencies of the "standard" design, whose reference is the "typical man" and for the limits of the "special" design, whose reference is the "different man". This approach focuses on the diversity of people, is inclusive and participatory, and is very similar to the postulates proposed by ergonomics and by human-centered design, that considers human needs as a priority.

2. Relationship between Ergonomics and Design for All

Chapter edited by Isabella Tiziana Steffan, Studio Steffan-Design and Research, Milano, ITALY and Francesca Tosi, Department of Architecture, University of Florence, Firenze, ITALY

The relation, and the points of convergence, between Ergonomics and Design for All have their origin in the attention with which the ergonomic approach to design addresses the specificity and complexity of each case - be it an evaluation or design of a product, an environment or a service. It starts with the identification of specific needs expressed by the individual user of the product / environment / service, as well as the specific conditions of the context in which this relationship takes place, their mutual influences and their variability in time.

This approach requires a shift in focus from the identification of so-called user profiles, traditionally defined by age and / or specific physical or cognitive impairments to a design approach based on the identification of profiles of needs, expectations, attitudes and desires related to the use of a particular product. It will also allow many different users to identify with the design.

Ergonomics can provide a great contribution in the conceptual and methodological transition from the design "for user profiles" and "for levels of ability or inability", to the design aimed at meeting the needs and expectations of many different users.

On a theoretical level, ergonomics may represent a concrete instrument of the Design for All approach, thereby making available the wealth of knowledge about human characteristics and abilities that by definition make up the theoretical multidisciplinary basis. It also offers a system of interpretative instruments which can be used to evaluate the design compatibility of the product in relation to the characteristics and abilities of the users the product is intended for.

The methodological system of ergonomics can also represent the necessary pragmatic contribution to Design for All. Its cognitive tools as well as the methods for evaluating the ergonomic quality of products may in fact represent tangible innovation tools of design and process, capable of translating into reality the ideas and contents of Design for All.

Since Design for All aims to consider all individual needs through a methodological approach, Ergonomics and Human-Centred Design methods can provide a structured set of methods for evaluating and interpreting the real needs of the users. In particular, evaluation methods based on users involvement (user trials, co-working, direct observation, interviews, thinking aloud etc.) are used to assess the relationship with the product, their possible sources of discomfort and / or frustration, and their expectations and desires.

3. Examples of Ergonomics and Design for All

3.1 Lighting – one size fits all OR design for all?

Chapter edited by Jennifer Long, Jennifer Long Visual Ergonomics Pty Ltd, Katoomba, NSW, AUSTRALIA, and School of Optometry and Vision Science, University of New South Wales, Sydney, NSW, AUSTRALIA

Open-plan offices pose a challenge for workplace lighting. Workstations are located within one room and may be demarcated by workstation dividers. These do not generally extend to the ceiling. The base building lighting is usually fixed-position non-adjustable ceiling luminaires (i.e. a one-size-fits-all design) which meets the maintenance illuminance requirements of a relevant standard (e.g. Australian / New Zealand Standard AS/NZS1680.2.2: 2008). Although the business which occupies the space has the option to modify this base lighting (i.e. install their own lighting design) this does not always occur.

A one-size-fits-all lighting design poses a visual ergonomics problem because workers within the workspace have different visual needs. Tolerance for light and glare varies between individuals, which may be related to age, ocular health, physical health or anatomical differences (e.g. pigmentation within the eye). Individuals may also have different lighting preferences even when performing the same task e.g. for digital graphic art tasks, some workers prefer to work in subdued illumination while others prefer well lit surrounds.

With one-size-fits-all lighting design, it is relatively easy to accommodate people who require more light for their work e.g. provide them with a desk lamp. However, the only option for accommodating those who prefer less light is to switch off the ceiling luminaires. This alters the light distribution within the space and may contribute to a gloomy appearance. It can also create tension within the workplace between individuals as well as create concern for managers who fear that they do not comply with the minimum lighting requirements specified in standards.

Is design-for-all lighting possible in an open-plan office environment? One option is to install reduced general illumination and provide shielded adjustable task lighting at workstations. This is not a new concept and is already pitched as an energy saving measure (Australian / New Zealand Standard AS/NZS1680.1: 2006). But it raises further questions. What is an appropriate "reduced illumination"? Would the space appear gloomy with low illumination? Would individuals who require higher illumination be at a disadvantage? Should lighting designers work more closely with architects to incorporate design elements to offset any visual disadvantages associated with reduced illumination (e.g. greater use of contrast for doorways)?

Research is urgently required to answer these questions as this will reassure builders, architects and business owners that alternative approaches to lighting are possible. Aspiring to design-for-all lighting is necessary if businesses continue to promote shared workspaces. Adjustable lighting is a logical solution for accommodating the different visual needs of individuals, and may also provide potential energy savings for business.

3.2 Ergonomics can reduce or eliminate barriers.

Chapter edited by Andrew Petersen, Ph.D., C.P.E., Ergonomist, WELL Australia, Queensland, AUSTRALIA

Many of the best people to enhance a business have a disability. Assisting people with a disability to reduce or eliminate issues and barriers related to their disability at various workplaces requires an individualised approach to reach a successful outcome. The use of normalised data is not appropriate when assisting people that have different abilities. What is required is an ergonomic design approach specific to the

individual and the industry in which they work. This approach ensures each solution is unique for the person and the work they need to do.

Various ergonomic strategies are used to determine the most effective and reasonable solution. Conducting thorough ergonomic assessments required an understanding of an individual's disability and, more importantly, their abilities. This knowledge is used in conjunction with task, work equipment and work environment analyses along with knowledge of standards and work practices. Only then can an ergonomist truly realise the myriad of difficulties an individual with a disability experiences doing their work tasks. Ultimately, the combination of information presents to the ergonomist a fuller, more developed picture of an individual's issues and barriers at work.

Once an ergonomist comprehends the big picture relating to the individual and their needs, solutions can begin to be considered. For example, equipment, work systems or environments can be modified or developed that accommodate an individual. Solutions need to be compatible with abilities and permit the work demands / work requirements. The ultimate goal of engaging an ergonomic design approach to resolving is to optimize performance within the person's abilities and provide a positive user experience, that is, without limiting their performance, enjoyment and pride in conducting a task.

Many solutions have successfully permitted workers with a disability to maintain employment, and in many situations, increased their duties and opportunities. Areas where ergonomic design approach had assisted workers included mobility around a variety of work places, modification to the built environment and vehicles, implementation of technology and development of specialised equipment designed for particular work duties in relation to worker's abilities.

Accommodating a person with a disability is possible. For example, an office worker with muscular dystrophy was unable to use the office building's lift call buttons. By combining information collected from different assessments, a solution was proposed for a relocatable touch screen that had reprogrammable lift call buttons. A prototype was made for initial testing (see figure 1). The results from these tests lead to the final solution that surpassed all the issues related to the individual plus the environmental and business challenges (see figure 2). One unexpected benefit from this touch screen device was that this single solution solved issues for other workers who were not originally involved in the initial project but were identified during the process.



Figure 1. The prototype made for initial testing.



Figure 2. The final result.

3.3 Design for challenging behaviour pleasant for all. The Wallara and Wintringham Homes Potter Street Dandenong.

Chapter edited by Allen Kong FRAIA, Architect, Allen Kong Architect Pty Ltd, North Melbourne, AUSTRALIA

When approaching a design for accommodation for homeless elderly or younger people with intellectual disability the designer may well begin with stereotypical ideas of the needs of these people as a group. If, however, the designer considers the person with individual physical and emotional abilities it is should not be a surprise to find there exists great diversity. Residents come from many different cultural backgrounds and with a range of co-morbidities. Designing for the breadth of each type of disability using researched criteria for conditions such as dementia, visual impairments, mobility difficulties etc. along with more specific understanding of the needs of challenging behaviours and alcohol induced impairments is not easy.

The Project here described is a joint venture between Wallara Australia, Wintringham and Housing Choices Australia: it was a great challenge. The main problem was that many Wintringham residents at Potter Street have been refused access to other facilities on the basis of their difficult behaviour.



Figure 3. Resident's bedroom with personally chosen colour scheme – a vast difference to the white on white of their previous accommodation.

The design method included research in the physiological and psychological responses to the built environment by many, including Lugg (health responses to place), Ghel (responses to and use of spaces), Passini (way finding in built environment) and many others including the practice of Feng Shui and Traditional Chinese Medicine.



Figure 4. Entry veranda with residents sitting out on their verandas.

Well-designed spaces support health and lifestyle while poorly designed spaces may create negative health effects. Each resident needs to be able to know that they have their own place. This is more than just having a private bedroom space, it includes also a semi private space under veranda where the resident can call their own and feel secure and observe the wider world (see figures 3, 4 and 5). That was just what Allen Kong Architect Pty Ltd specifically tried to implement.



Figure 5. Resident's room with space outside for him to create his own place.

The solutions provided were specific to climate, location, residents and staff organisation however the principles of design can be adapted to other situations. To be called home, a place should be familiar, and be physically and cognitively supportive. Moreover it can also be a pleasant place for everyone.

The residents were happy with the design solutions. The management and design enabled individuals with challenging behaviour to live comfortably live together and comfortably without the need for chemical restraint.

3.4 Mobile Phones: A key to unlocking disability citizenship

Chapter edited by: Jenny Green, Simon Darcy, Hazel Maxwell, University Technology Sydney, AUSTRALIA

Community Connections Australia together with the NSW Department of Ageing, Disability and Home Care entered into a collaborative development project involving telecommunications technology, smart phone or tablet based hardware and a suite of software to assist people with disability. The outcome was 'Jeenee' which was developed to facilitate people with disability, their families and carers to live more independent lives. Literature reviews of studies of Information communication technologies (ICT) use with people with disability with significant support needs conducted over the past 25 years generally agree that there is real potential for the use of these technologies (Guo, Bricout, & Huang, 2005; McKnight, 2014; Thornton, 1993; Watling, 2011; Wise, 2012) and that the area of ICT warrants greater attention as a tool for teaching, training

and support (Pennington, 2010; Wehmeyer et al., 2006). However, they also agree that there are significant limitations due in part to the commercial software available and the usability of the hardware. Nonetheless, the speed of development in ICT is unprecedented (Mitchell, 2005) and the possibilities of new ICT products for people with disability with significant support needs continue to be explored (McKnight, 2014; McNaughton & Light, 2013). The Jeenee products are designed to empower people to develop new skills and increase their independence and autonomy. This research explores the adoption and use of Jeenee by considering the effect on community integration and participation of the people with disability, the perceptions of the effect on community integration of the technology on people with disability by their significant other, attendant, carer or guardian and explores the impact of Jeenee on the management of disability services.

The research design adopted for the project included: observation; interview techniques; online surveys; and management information systems. This involved drawing a sample from 152 people with a disability involved in the Jeenee pilot and interviewing the people with a disability (N = 15), their significant others and their support manager where applicable. The participants consisted of seven women and eight men and were comprised of ten participants with intellectual disabilities (of these ten, two also had physical disability and three also had sensory disability), five participants had no intellectual disability but instead had physical disability (two of these participants also had sensory disability and one had a brain injury). Participants were recruited and interviewed about their level of community integration and participation. Interviews followed a semi structured interview guide and occurred at the beginning, at the mid-point and at the end of the three month pilot period.

The people with disability found the use of the Jeenee technology enabled them to communicate and share events and information more extensively particularly with family members. From the 15 people involved in the study a typology of user was identified. Three user typologies were identified: evangelists; embarkers; and discontinuers.

The evangelists were extremely enthusiastic Jeenee users, the embarkers were happy to try something new while the discontinuers withdrew and ceased to use the phone. Six clients or 40% of the sample could be defined as Evangelists. These clients displayed a strong belief in the value of the Jeenee technology in their lives. These clients were high adopters they relished using the Jeenee phone and used it on a regular basis for a range of activities which included communicating with friends, family and service providers. They felt confident contacted the Jeenee Help Centre for advice and assistance and often used their services. They really enjoyed using their phones and integrated them into their everyday lives with few problems. Four of the clients or 27% of the sample could be defined as embarkers, they had begun to embrace the technology. These clients and their significant others were keen to get on board with the Jeenee technology. They used the Jeenee phone for some activities such as communicating with family either by calling them or by text and some made calls to the Help Centre. However these clients did not always use the technology to its full potential and were not overly enthusiastic about the phone. Five of the clients or 33% of the group showed little interest or could not readily use the Jeenee technology. This group terminated their involvement with Jeenee following the pilot. These clients used the Jeenee phone infrequently as many have an alternative phone or had technical issues with their Jennee phones which made it difficult for them to use them. Significant others talked about the benefits of the technology in terms of security, safety and independence. The service providers also appreciated the benefits in terms of independence for the people with disability. However, significant others and service providers also outlined technical, behavioural and roll out problems that the users had experienced which involved adapting the technology to suit different abilities and developing appropriate phone etiquette.

4. Conclusions

Design for All takes into account as many people as possible and is essential in the design of workplaces or public places, in all places frequented by people that are completely different from each other, of services provided to the community and of products in general. The various techniques of participatory planning typically used within ergonomics are indispensable in achieving these goals

Further research and exploration is require to address the complexities of implementing a design for all approach, for determining the most suitable methodology and tools, and for selecting specific targets for the scale and scope of each design. The path to Design for All has just begun.

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