

THE PRINCIPLES OF INCLUSIVE DESIGN

Flavia Bonilha Alvarenga

Universidade Estadual de Campinas – DPM/FEM/UNICAMP – C.P.- 6122 – Cep 13083-860 Campinas - SP
flavia@fem.unicamp.br

Franco Giuseppe Dedini

Universidade Estadual de Campinas – DPM/FEM/UNICAMP – C.P.- 6122 – Cep 13083-860 Campinas - SP
dedini@fem.unicamp.br

Abstract. *The world population is aging and the number of people with special needs is also increasing. Nowadays, new technology and products have been developed to improve quality of life. In general, the products are designed for a specific target, the able-bodied people, excluding the rest of the population. It is known that many products are not accessible to large sections of the population. Hence, there is an urgent need for developing an inclusive methodology based on better understanding of the principles of inclusive design, which will lead to minimizing the impact of impairments and thereby extend life quality. A discussion about what constitutes good inclusive design is presented. The aim of this paper is to introduce and discuss the principles of inclusive design for implementing an inclusive methodology.*

Keywords: *Inclusive design, Design for all, Inclusive methodology, Inclusion, Accessibility.*

1. Introduction

The world population is aging and the number of people with special needs is increasing. There is a need to design inclusive products to accommodate this wide range of capabilities and develop a methodology to guide the designers.

The design of a product, when initiated, follows a sequence of events, in a chronological order, forming a model, which usually is common to all the designs (Back, 1983). This model is called design methodology and is composed of some methods. There are many references of systematization on product development (Back, 1983); (Blanchard and Fabrycky, 1990); (Ulrich and Eppinger, 1995); (Pahl and Beitz, 1996); (Ullman, 1997), and all of them focus on target people.

Designers instinctively design for able-bodied users excluding older and disabled people. Therefore, many products are not accessible to large sections of population.

There is a need to develop a methodology to guide the designers to develop products for cover all the population. The aim of this paper is to present a review of the inclusive design approaches and to give a base in order to propose a methodological design approach for implementing inclusive design.

2. Inclusive design approaches

There are many design approaches for users with impairments. Most inclusive design approaches define the target population as being older users, functionally impaired users or the whole population. One common approach is to design specific solutions for specific needs.

For instance, “Rehabilitation Design” (Keates, Clarkson and Robinson, 2002) focuses on developing solutions for specific impairments. “Design by Story-Telling” (Keates, Clarkson and Robinson, 2002) is a similar approach but with emphasis on age. Both methods focus on either the elderly or the disabled as minority groups to be catered for by own special needs products to improve their impairments. It is more acceptable to produce products that are inclusive without labeling the users.

The “User Pyramid Design” reflects the wide range of user capabilities and their impact on the design process by categorizing the target user capabilities (Benktzon, 1993). The user population is described in three broad bands. The able bodied, fully capable make up the base of the pyramid, those with reduced strength and mobility comprise the middle level and the severely impaired occupy the peak. The approach claims that if products are designed to be accessible by a particular level, the resultant product will be accessible by those less severe or no impairments. This is an important re-think of inclusive design approaches as it allows for both the possibility of different products for different people, and notion that products can reach across the boundaries capability.

In order to obtain a more inclusive design, some design approaches have been developed, and these are presented on sections 2.1, 2.2 and 2.3.

2.1. Design for all

“Design for all” (DFAI) have a concept of designing products and environments that not exclude significant sections of the total user population (Case *et al.*, 2001). The needs of old and disabled people are considerate alongside

the younger and able-bodied population to ensure that products are equally appropriate for all users (Case *et al.*, 2001). On the other hand, the design for disabled, approach to find needs of disabled people. It is considered to provide products that will appropriate for that section of society. However, the philosophy “Design for All” promotes the development of products that meet the requirements of a broader section of the population, including those who are older or disabled, to minimize the need of individual customization.

Marshall *et al.* (2002) reported that in year 2005, there will 10 million older and disabled people in Europe, about 25% of the total European population. Therefore, it is essential that designers have a guide to design for this increasing population. DFAll aims to educate designers in the importance, both socially and economically, of accommodating this population. DFAll promote an approach focused on product accessibility and usability aimed for providing products that meet requirements of a larger proportion of population (Marshall *et al.*, 2002). Such products should include features that accommodate and appeal to able-bodied users and those who are older or disabled.

2.2. Universal design

The intent of “Universal Design” (UD) is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost. “Universal Design” benefits people of all ages and abilities (Story, Mueller and Mace, 1998).

The UD is a design approach that maximizes usability of products, services, and environments for everyone- young people and old, short people and tall, people with disabilities and without (Bowe, 2000). “Universal Design” can be defined as the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities. “Universal design” respects human diversity and promotes inclusion of all people in all activities of life (Story, Mueller and Mace, 1998).

In 1997, the “Center for Universal Design” at North Carolina State University coordinated the development of seven principles of “Universal Design”. The seven principles are intended to provide guidance in the design of products and environments (Story, Mueller and Mace, 1998). The principles of “Universal Design” are listed below.

Principle 1: Equitable Use. The design is useful and marketable for people with diverse abilities.

Principle 2: Flexibility in Use. The design accommodates a wide range of individual preferences and abilities.

Principle 3: Simple and Intuitive Use. Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

Principle 4: Perceptible Information. The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

Principle 5: Tolerance for Error. The design minimizes hazards and the adverse consequences of accidental or unintended actions.

Principle 6: Low Physical Effort. The design can be used efficiently and comfortably with minimum fatigue.

Principle 7: Size and Space for Approach and Use. Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture or mobility.

These principles promote a point of view about how to make a good inclusive product. That will help in developing of the new methodology. The process of developing the principles and examples of designs that satisfy each could be found in Story, 1998.

“Design for all” and “Universal Design” have the same aim. Both discuss about to design products that are suited for all population and is particularly concerned with including those groups such as old and those with disabilities that might previously not have been considered.

A number of different terms have been used to describe the goal of non-exclusive design. That includes “Design for Disability”; “Universal Design”; “Transgeneration Design”; “Design for All”; “Design for a Broader Average”, and other terms (Keates, Clarkson and Robinson, 2002). In this paper will be refer to “Inclusive Design” as designing for the whole population.

2.3 The Inclusive Design Cube (IDC)

There are very few structured approaches that describe the implementation of “Universal Design” (Bowe, 2000).

There is a need to develop an inclusive methodology and also provide appropriate tools and data for supporting designers to inclusive design.

The inclusive merit of a product depends on two criteria: the merit of the requirements that, define the product, and the merit of the product when judged against those requirements (Keates, Clarkson and Robinson, 2002). A simple graphical representation offered a visual summary of the level of inclusion achieved by the design. One such representation tool is the “Inclusive Design Cube” (IDC) (Keates, Clarkson and Robinson, 2002).

The IDC highlights the different design approaches that can be used to develop products appropriate for a given range of capabilities. It was known that the principles of inclusive design generate products widely accessible to the population and hence good population coverage. This approach denoted “User-aware design”, dominates the cube.

For severely impaired users, it may be necessary to adopt rehabilitation design approaches of custom products for specific users, “Special purpose design” in Fig. 1. In between the two approaches is an intermediary design approach with flexible boundaries. “Customizable/modular design” takes a base unit designed using the “User-aware design” principles, but with a changeable interface that is either adaptable or can be swapped for one of a series of modular designs. The “Inclusive Design Cube” is a very potent visualization tool and communicates the needs of different sections of the population. However, for practical implementation of inclusive design practices, it is necessary to supplement it with a systematic design approach.

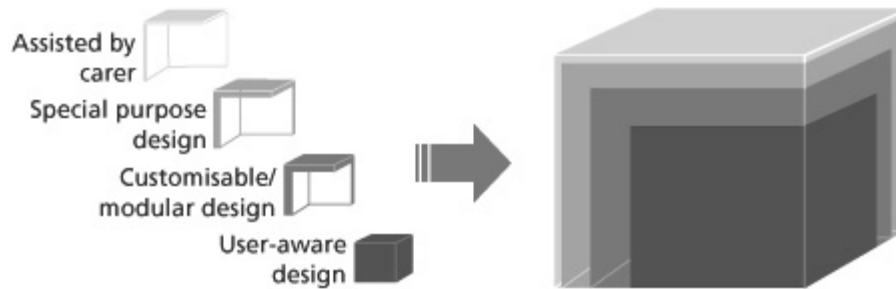


Figure 1. The “Inclusive Design Cube”.

3. Defining population (Keates and Clarkson, 2003)

In order to get an “Inclusive Design” it is necessary, firstly, to define the populations. Currently design involves identification of a need and of a target population. It is necessary to define the terminology for the population. The global population is the maximum number of people who could use the product. This may be referred as the “Whole Population” (Keates and Clarkson, 2003). These include all people of all ages and capabilities.

However, there are those who would be incapable or people who are prevented by law, safety considerations of using the product for its intended purpose is the “Ideal Population” (Keates and Clarkson, 2003). This is the maximum population that a product could possibly target.

The new product will be first be defined by a specification or set of requirements, before any product concepts are developed. A population can then be defined on such requirements. This is referred to as the “Negotiable Maximum Population”, where “negotiable” reflect the fact that this population is not fixed and can change as the requirements change (Keates and Clarkson, 2003).

As soon as anything physically tangible is produced, like prototypes, it can be evaluated. This means that at any stage of design process progresses, the inclusiveness of the product can be evaluated from the physical properties, are referred as the Included Population (Keates and Clarkson, 2003).

A further population of interest may be the “Intend Target Population”. For instance, the target population could be particular age groups, or particular socio-economics groups. The “Intend Target Population” will often be defined based on the “Whole Population” or the “Ideal Population” only (Keates and Clarkson, 2003). However, its size and composition is independent of the “Negotiable Maximum Population” and “Included Population” (Keates and Clarkson, 2003).

In summary, these five populations may be referred to as “WINIT” (Whole-Ideal-Negotiable-Included-Target) and used to form the basis of measures of success for inclusive design, or better saying the inclusive merit (Keates and Clarkson, 2003).

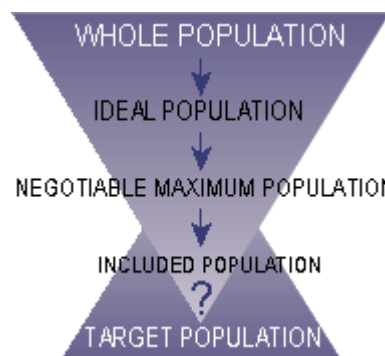


Figure 2. The WINIT populations.

4. Developing a more inclusive methodology

In order to develop a design approach it is necessary to treat the new approach as a product and adopt a three stage development strategy (Keates and Clarkson, 2003):

Stage 1 - define the problem - gain an understanding of the current shortcomings of design for all;

Stage 2 - develop a solution - develop a design approach that takes into account knowledge about able-bodied and motion-impaired users;

Stage 3 - evaluate the solution - make sure that the design approach is effective.

The solution itself is also a three stage product development strategy: Stage 1 - define the problem - gain an understanding of the product requirements; Stage 2 - develop a solution - develop a design solution that takes into account knowledge about able-bodied and motion-impaired users; Stage 3 - evaluate the solution - make sure that the product is effective. It is important that each stage of this product development is user-centered (Keates and Clarkson, 2003). In summary, there is a need to adopt a rigorous, methodical process for developing the new design approach and the resultant “Design for All” is, in turn, a rigorous, methodical product development process.

4.1 The 7- level methodology

To provide a complete design approach it is necessary to define and structure the design phases that are direct to apply. The “7- level methodology” has been developed by Keates and Clarkson (2001) for developing an interface for universal access. This methodology serves as example in order to develop a more “Inclusive Design”.

The levels of this methodology (Fig. 3) are explained to follow (Keates and Clarkson, 2001): The Level 1 defines the user needs that are the social motivation for designing the product. This can be identified through questionnaires and interviews. Level 2 focuses on specifying the required utility of the product. Levels 3 to 5 focus on the stages of interaction. Usability and accessibility techniques can be applied directly to these levels, as can anthropometric and ergonomic data. The prototypes also are made in these levels. Level 3 addresses how the user perceives information from the system. The Level 4 makes the simulation of the system in order to compare the virtual and real situations. Level 5 focuses on the user input to the system.

The Level 6 involves the evaluation of the complete system to ensure satisfactory accessibility. The Level 7 evaluates the resultant system comparing with the necessities of the user. This level is the validation of the system made by the user.

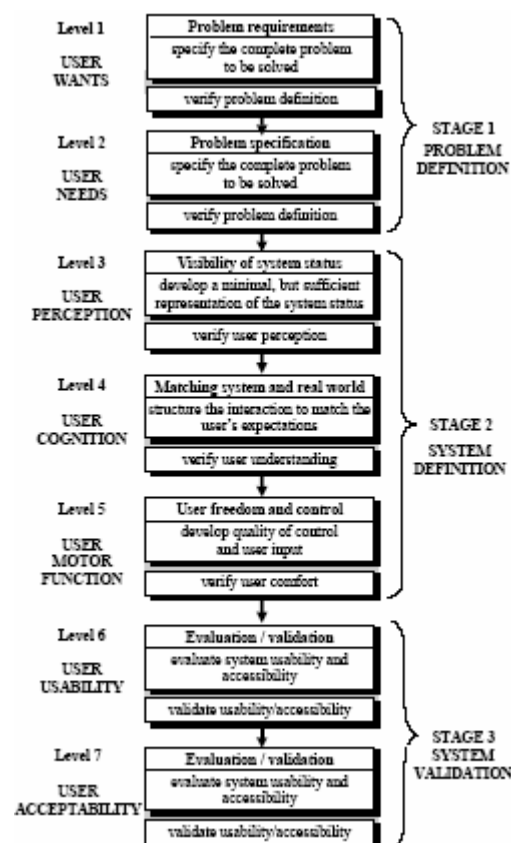


Figure 3. The 7-level design methodology

Both the “7-level methodology” and the “Inclusive Design Cube” focus the interaction consisting of perceptual, cognitive and motor actions. Therefore it is possible to combine them during the project process (Keates and Clarkson, 2001).

The IDC can be adapted to monitor the progress of the design by indicating the population coverage achieved by different design choices.

Effectively, the “7-level approach” can be thought of as designing for each axis on the cube. The modification necessary to use the IDC for this is a straightforward re-labeling of the axes to reflect Levels 3 to 5 of the 7-level design approach. (Keates and Clarkson, 2001). The resultant “Inclusive Design Cube” is shown in Fig. 4.

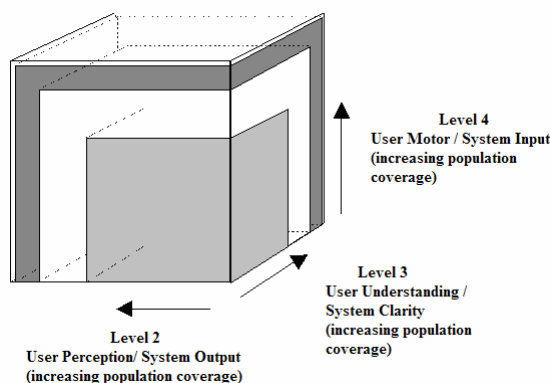


Figure 4. The IDC for use with the “7-level methodology”.

5. Further research

The aim of future research is to provide reliable data and information for designers that will lead to products to enable independence for the whole population. This process will bring together existing literature and design guidelines, which are currently dispersed, define a framework for successful product development. The principal objectives of future research are:

- to quantify the nature, range and clustering of capabilities across the population;
- to classify approaches to inclusive design;
- to develop design tools for inclusive design;
- to develop inclusive guidelines;
- to disseminate the results.

6. Conclusion

A review of approaches to “Inclusive Design” was presented. The “Inclusive Design” is a new subject in Brazil, and must be more explored and discussed. This paper presented some aspects about “Inclusive Design” for supporting material for developing a new inclusive methodology. The IDC and the “7- level methodology” (Keates and Clarkson, 2001) are good tools in order to develop a more inclusive design. However, a methodology of product development does not exist that establishes an organized structure aiming at the design for all. In general, the products are designed for a specific target, the able-bodied people, excluding the rest of the population. It is known that many products are not accessible to large sections of the population. Therefore, a methodology is necessary that can structuralize the phases of the project, and to guide the designer.

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9. Responsibility notice

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