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Ergonomics for the inclusion of older workers in the knowledge workforce and a guidance tool for designers

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ABSTRACT

The ageing of the population and the inverted population pyramid is bringing important changes to society as a whole. These changes are associated with the inclusion of an older workforce in knowledge work and the challenge they represent in adapting the work environment accordingly. In order to approach a more universal design of the work environment, industrial designers need support from user-sensitive inclusive design studies. While there are plenty of guidelines and tools containing relevant information, there is a need to develop more appropriate tools for Industrial Designers that cover the initial phase of the design process. This study provides a review of the available tools and guidelines and proposes a theoretical framework intended for developing a design guidance tool for inclusive workstation design.

1. Introduction

An inverted population pyramid is predicted for 2050 (Jackson, Initiative, and Plan, 2011; Serrano et al., 2014). The proportion varies from one country to another: more than 23% of the population will be over 65 in Japan and in the US, and 17.9% of the population will be over 65 in Europe (CIA, 2010). Moreover, in the Basque Country (northern Spain) the percent of the population over 65 has reached 18.5% percent (17% in the rest of Spain) in the last 16 years, and that percentage is predicted to keep growing (Fig. 1). This requires a deep transformation of our model of society.

This current study is framed within the strategy promoted by the Basque Government of enjoying the advantages that will come with the potential increase in an older population and what their expertise, know-how and relationships represent, where "knowledge" is the raw material. The idea is to prevent the loss of all the knowledge that has been acquired by these people throughout their professional career, knowledge that implies change, growth and internal enrichment that is beneficial to the organization they work for, which results in "knowledge capital".

A great part of national income is derived from knowledge-based industries, were the knowledge workforce plays a significant role. Knowledge-based industries are classified by the Organization for Economic Co-operation and Development (OECD) as manufacturing, financial services, business services, telecommunications, education, and health services. As knowledge work grows in significance, the door to further opportunities is opened to society, wherein we can take advantage of valuable elements that senior knowledge workers can provide us with, namely motivation, experience, knowledge, know-how and the relationships that have been cultivated over their personal experience and professional career. The trends point to an increased number of older knowledge workers, reaching numbers that have never been seen before (Myerson et al., 2010; Shiokawa and Hagino, 2002). Older knowledge workers also benefit from being active in knowledge work as well by having social contact and by feeling valuable. The changes in activity that older people experience have been studied from the perspective of the Activity Theory of ageing (Neugarten et al., 1961) and the Disengagement Theory (Havighurst et al., 1964). The Activity Theory explains the progressive drop in the activities that were previously part of an individual's daily normal life pattern and the process of progressive disconnecting between the individual and society. The Disengagement Theory supports the idea that the ability to stay active is one of the fundamental conditions for living successfully after retirement and while ageing.

'Universal design' is defined as "the design of products and environments usable by all people to the greatest extent possible, without the need for adaptation or specialized design" by North Carolina State University (Mace, 2004). 'Universal design' originated in construction and web site design (Waller et al., 2015;

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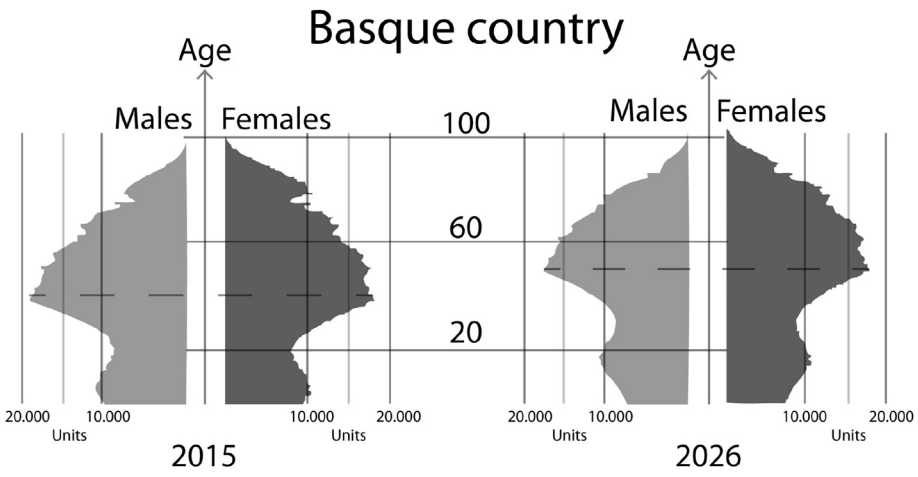

Fig. 1. "Population pyramid inversion in the Basque country for 2015 (left) and 2026 (right)".

Design for All Foundation, 2015; Klironomos et al., 2006; Preiser and Ostroff, 2001), and thus public spaces and housing have received most attention (Shiokawa and Hagino, 2002). Shiokawa and Hagino also point out the necessity, advantages and disadvantages of focussing on the workplace, and of offices in particular, in order to face the challenge of the ageing population, that 'Universal design' can sometimes be used as a synonym for 'Inclusive design', and that 'Universal design' benefits those with similar disabilities at the same time (Shiokawa and Hagino, 2002). 'Inclusive design', in contrast, originated with product design, and although it follows the same principles, there are some differences that make 'Inclusive design' more appropriate for product design, as the 'Inclusive Design research centre' webpage (OCAD University, 2015) explains.

Age changes do not occur to the same degree or in the same amount in every person. Instead, there is great diversity among older people. Though most people today often reach old age with better health and fewer age-related issues than their predecessors, intra-individual changes are significant for design (Kothiyal and Tettey, 2001). Age is also related to the decline in physical and motor skills (Smith, 2008b), such as reaching, bending, dexterity, sight (Maguire et al., 2014), perception, memory and understanding, among other changes (Chavalkul et al., 2011). Emotional changes as the so-called positive effect (Carstensen and Mikels, 2005), or the influence of past experiences, or values change in favour of personal and social relations.

As a consequence, the contemporary marketplace should evolve to satisfy the needs of more mature users too, extending beyond those of physical size, movements and force applications. Variations also expand expectation, interpretation, perception and physical characteristics (Hitchcock et al., 2001). More attention is being paid to workplace stress, which is often related to musculoskeletal issues and which needs to be addressed in a holistic manner (Osmond, 2013). True inclusive design must engage the wider population as actual users, not just potential users (Reed and Monk, 2011). Current work environment (tools, workstation, and workspace) requires a more inclusive design in order to cope with these age-related changes, treating age-related requirements as mainstream. Moreover, new generations bring along new working styles, new technologies and new ways of interacting.

This problem has been addressed by relying on the user's ability to adapt. Users become concerned about consequences; they go through training sessions, follow ups, and manuals. The problem is that these solutions too often require a lot of effort and carry an associated human cost (Tsai et al., 2012; Porter Mark et al., 2004); in addition, the solutions are costly and do not always address the problem, or at least not efficiently enough. Relying on design and ergonomics instead can provide a more suitable option. As Kawahara and Narikawa note in their study, it all boils down to the question of how we focus on the users and on humanitarian considerations when thinking about the interface between the user and artificial objects (Kawahara and Narikawa, 2015). Designers play a critical role in promoting inclusive design practice (Dong et al., 2015).

The main idea is to address the needs of the knowledge workers who use workstations. The problem is that the components of these workstations have been designed for a context that has evolved and is expected to evolve through changes in the workforce, organizational factors and activity, while the product, the workstation has not evolved enough. In the introduction this problem and design can play an important role in addressing population ageing. In Section 1.1. State of the art shows how this problem has been addressed, and the fact that there is a gap between designers' needs and ergonomics and human factors research. In Section 1.2 it is explained that ultimately it is the users' needs that will benefit as a result, it is however, necessary to intervene through designers; designers' needs are also to be addressed in the current study. Then what content is required to develop such tool framework is presented in Section 2, discussed in Section 3 and finally It is concluded that being coherent with an ergonomics system perspective, the product design, the workstation, has to evolve accordingly and the presented points are especially relevant to build upon them the future tool that serves as a bridge from ergonomics and human factors research, to designers' understanding and application in practice.

1.1. State of the art

After conducting a literature search, numerous works have been found regarding ergonomics in the workplace. However, these mainly focus on functional ergonometric characteristics, the physical or sensory aspects of ergonomics. These studies contain posture measurement tools, assessment and recommendations (UNISON, 2003; Osmond Group Limited (Osmond), 2015; Office Ergo), anthropometric data (Kaklanis et al., 2012), methodologies, ISO Standards (Bevan, 2006), etc., all of which are relevant for workstation design and development.

There are multiple standards in CEN-CENELEC and ETSI for office environments, but they are based on current standard users and do not address inclusive purposes regarding older users. On the other