EXTENSION OF WORKING TIME IN POLAND AS A CHALLENGE FOR ERGONOMIC DESIGN.

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Abstract: Abstract: Demographic changes, combined with the economic situation, give rise to extended working hours. This means that we will spend more time at work, and the work will be performed by a person in various ways not adapted to it. Currently in Poland, the number of people of retirement age is 16.91% and in the future it is estimated that it can reach up to 30%. What's worse, the age distribution of the population is changing, as more than one third of Poles in 2020 will be aged over 50 years. Undoubtedly, the increasing age of workers means a reduced efficiency in many areas. The declining efficiency of older workers should therefore be compensated for with measures in the field of ergonomics, which on the one hand would allow workers to remain longer in an optimal mental and physical condition, and on the other hand would make it possible to design a suitable working environment. In the following paper, the author presents aspects of design related to elderly workers, as well as the factors to be taken into account when selecting an employee for the specified task. Also presented are concepts of the modernization of selected work positions and systemic solutions regarding the work of the elderly.

Keywords: ERGONOMICS OF AGING, ERGONOMIC DESIGN, ELDERLY WORKERS

1. Introduction

In recent times, the topic of aging has become a major and often undertaken scientific problem. The reason for increased interest in this area is the emergence, and the subsequent recognition, of the so-called “problem of old age,” which is generally based on the fact that the number of people able to work has decreased relative to those who have lost this ability, which is a direct consequence of a longer life span and a reduced mortality alongside a reduced number of births. This problem is due to the demographic changes that are taking place simultaneously in all European countries and is known by demographers as a demographic transition (Kędelski M., 2006).

However, the recognized and often described from the demographic side problem contains a number of different aspects: social, economic, physiologic-rehabilitative. Without denying the weight of the mentioned aspects, the sciences pursuing this problem (demography, medicine, economics, social sciences), due to their specificity, are identifying-descriptive. Thus they cannot on their own cause a reduction in the problem of old age and can only limit some of its effects and describe trends. Hence the interest in ergonomics, an interdisciplinary science that has the tools for both identifying the problem and finding the optimal solution for it.

The interest garnered by ergonomics is due to the fact that it is the science of adapting technical objects for the psychophysical abilities of humans and is primarily engaged in optimizing the operation of any system: human – technical object (Tytyk E., Butlewski M., 2011, p. 8). This interest in the design of technical solutions is based on the fact that ergonomically designed objects primarily improve workplace safety and health and reduce the mental workload of employees (including optimizing stress), and also translate into an increased quality of work and satisfaction from its course (Jasiulewicz-Kaczmarek M., 2012). Ergonomic design is thus geared to obtain the desired (relevant - directionally significant) level of ergonomic quality of the human – environment system (Tytyk E., 2001, p. 100), which creates the greatest chances for the mobilization to work of people with a reduced performance, such as the elderly. In this way, achieved is not only the ability to perform a particular job, but also the greater desire of the elderly to undertake it. The optimal choice of production methods aimed at ergonomic design also allows for achievement of such product parameters, which make it resistant to the occurrence of some abnormalities in the manufacturing process itself, which obtains a minimal loss of quality, with the planned cost of production (Mrugalska B., Kawecka-Endler A., 2012). Taking the path of ergonomic design, a high efficiency of the work performed (Górny A., 2012) is obtained at a low cost (load) to the human. Furthermore, the development of ergonomic working conditions as well as such devices allows for ensuring a high efficiency of utilization of technical objects at a relatively low risk of human error (Sławińska M., 2011). It is such actions, contained in the paradigm of ergonomic design, that are the best method of encouraging older people to undertake work and convincing employers that older people can be valuable employees, despite the clear limitations of age.

Presented in this article is both the context of ergonomic design for the elderly (including the concept of obtaining the data necessary for the design process) as well as the legal and morphological context of the elderly.

2. Features of aging from the ergonomics point of view

When considering the problem of aging, defined must be the boundaries of the concept as well as its features, which are particularly important from the point of view of ergonomic engineering (ergonomic design). These features in most cases are not of a discrete nature, but because of the continuity and longevity of the changes, for which we observe the consequences in “old” age, should be subject to particular consideration.

Reflecting on the term “old age,” the conclusion is that it is not a clear concept, which we discover while aging, when the border of what is old age shifts as we age. The ambiguity also results from an increasing life expectancy, which over several centuries has doubled. However, for the purposes of classification, a conventional agreement on the borders of what is old age must be made, which is also not easy to determine, because, as mentioned above, processes of defining it are not discrete. Thus, at least a few categories can be distinguished that could serve as a criterion for determining the boundaries of old age:

- social - the moment of loss, weakness of present function or of acquiring a new function in society,
- legal - the moment of acquisition or loss of certain privileges of an economic and legal character - the moment of retirement,
- biological - the moment of decline or achievement of a certain value of selected physiological functions of the body,
- metrical constituting a simplification of the above.

The literature on aging indicates, among others, the following metrical boundaries:

- from 45 years (Klonowicz S., 1979)
In common knowledge, old age began once people reached retirement age, and so, until recently, 65 years for men and 60 for women. However, with the increasing retirement age, which at the time of writing this article is 67 years for both men and women, this limit even in the layman’s sense no longer distinguishes those who are “old” from the “young.” It must be added that the further “extension of working time” is rather essential.

On the basis of the above-mentioned age borders, it can be indicated that old age begins “already” at about 50 years; at least from this age it is the interest of ergonomic design. Of course, age is not a uniform (discrete) state and in literature the development can be found of a categorization of old age into (Szatur – Jaworska B., Błędowski P., Dziegielska M., 2006 p. 47, Bielak M.. 2011, p. 32):

- from 60 to 69 years, early old age,
- from 70 to 74 years, transitional age between the early and limited-efficiency ages,
- from 75 to 84 years, advanced old age,
- over 85 years old, infirm old age,

However purposeful the shown above categories are it should be noted that they are conventional in nature and are not linked to a specific psycho-physiological limit. There is therefore no doubt that the category of elderly people (old), can cover a much wider group, also because the considered divisions should serve to determine the scope of the group in question for the purposes of the project. All the more correct, since limits in efficiency inherent in the aging process begin much earlier. Given these considerations, it should be noted that:

- above 30 - 35 years of age mental “capacity” steadily declines (Klonowicz S., 1979)
- above 28 - 30 years the diameter of bone (tibia and fibula) decreases (Klonowicz S., 1973)
- above 25 years MVC (maximum voluntary contraction) decreases (Marchewka A., Dąbrowski Z., Żołądz J.A., 2013)
- above 35 years of age the body's physical capacity measured by maximal oxygen uptake capacity (VO2 max) decreases on average of about 0.9% per year (Żołądz J.A., Majerczak J., Duda K.., 2011)

Therefore, if elderly people, in relation to young people, have a decreased psychomotor performance and overall efficiency these features should be treated as ergonomic categories of design for the elderly. Thus we can include the following elements to be taken into account for the design of work systems for the elderly:

- anthropometric characteristics of the elderly population and their range (previous studies assumed a population of workers aged up to 65 years for men and 60 for women), (Nowak, E. 2001)
- ability of effectors in terms of physiological characteristics: maximum strength, maximum strength maintenance times, and for psychomotor characteristics: reaction time, motor coordination, movement precision, etc.,
- overall ability of the body in the form of total capacity, measured by maximal oxygen uptake capacity, the ability to maintain a static position, etc.,
- ability of receptors - levels of hearing, range of acute vision, sensing of vibration, radiation, etc.,
- ability to acquire information (reading with understanding, selecting content out of information noise, etc.),
- ability to process information - mental capacity - memory, abstract thinking, ability to connect sentences, attention, etc.,
- resistance to the external environment including susceptibility to physical factors of the work environment (vibration, noise, microclimate, electromagnetic radiation, dust and lighting), and technical and organizational (work breaks, supervision, etc.)
- preferences and personality patterns including beliefs, standards of beauty, relationship to the environment, etc.)

The above elements are categories of design criteria for the development of ergonomically conditioned elements of the work environment for the elderly, because these elements can distinguish the elderly from the general population. It should be noted that ergonomic design creates only the base for the creation of ergonomic products, and only their accurate use under appropriate conditions, by an appropriately selected and trained individual, allows to describe the performed work as ergonomic. Thus, nothing is ergonomic in and out of itself, because even the most ergonomic becomes unergonomic by inappropriate use (Butlewska M., Tytłyk E., 2007).

### 3. Legal regulations concerning the work of the elderly

In accordance with the Polish act from May 11, 2012 amending the law on retirement and disability pensions from the Social Insurance Fund (FUS) and other acts OJ 2012 No. 6 pos. 637, there is a significant prolongation of the period of employment for women (from 60 to 67 years) and men (65 to 67). The extension is done gradually - every quarter of the birth year by a month - from 60 years and 1 month for women born from January 1, 1953 up to 67 years for women born after September 30, 1973. This means that the age border of 67 years will be effective for women retiring in 2040. For men, this limit will be reached 20 years earlier because retirement age was extended by “only two years.” Concurrently, other legal conditions should be mentioned that relate to the elderly at work, namely:

- Art. 92 of the Labor Code, which causes less load on the employer to pay long-term illness costs (up to 14 days for persons over 50 years of age, instead of 33 as in the case of other employees under the act from December 19, 2008 amending the law on employment promotion and labor market institutions and amending certain other acts OJ 2009 No. 6 pos. 33),
- Art. 39 of the Labor Code, which prohibits the termination of work contracts to the employee, who has no more than four years to retirement age,
- Art. 11, 18-3a, and 39 of the Labor Code, which prohibit discrimination in respect of, among others, age (as well as gender, disability, race, religion, nationality, political views, labor union membership, ethnic origin, sexual orientation).

The exception to the above Art. 18-3a of the Labor Code is the differentiation of allocation of resources due to disability or parentage and the use of the criterion of work experience (Art. 18-3b, par. 3 and 4 of the Labor Code).

Presumably, with the increasing retirement age and foreseeable future limitations of pensioners’ income (ONLINE www.regiopraca.pl/)) further legislative work will be needed with the goal to improve the legal situation of the elderly. However, such solutions may turn out to be ineffective or even acting against the elderly, as is the case with Art. 39 of the Labor Code, which causes a “prophylactic” firing of workers before reaching four years to retirement age (ONLINE http://www.olbrzym.info).
4. The extent of “old age” in Poland

Designing requires quantitative data on the target population. The problem of old age, as mentioned at the beginning, has been widely described in literature with the nature of demographic analysis (Paradyż J., 2012). The performed projections indicate an increase in the proportion of older people in relation to the general population, which is characteristic of regressive populations (aging or dying). A discussion of the problem would require a separate publication, thus without analyzing the causes of this situation, it is clear that a growing proportion of elderly people will cause an increasing interest to take into account their needs in different areas of life. In Poland today, according to data from the National Census in 2011, nearly 35% of the population has exceeded the age of 50 years (34.89%). The trend in this area is also demonstrated by the percentage of people aged 50-59 years - 15.1% in Poland. The differences between the different regions of Poland in this respect are shown in Figure 1.

An analysis of the distribution and quantitative status of the elderly, as in the case of people with disabilities, can be an important guide for ergonomic design (Butlewski M., 2012). A possible estimation in this area may allow for intensifying the meeting of needs occurring most commonly in a given area, which of course is justified in the case of design solutions for a loosely defined group of recipients.

The mentioned at the beginning prolongation of working time of up to 67 years will apply to women under 58 years of age and therefore will include close to 77% of the female population and over 80% of men (ONLINE http://www.stat.gov.pl). This assumption of course takes into account the load the extended working time puts on people just born, who are yet to enter the labor market. This means that the need for solutions that support an extended working time will address the majority of Polish people. It should be noted, however, that the statutory extension of working time does not actually mean the extension of working time for all who are included in the new work system. The percentage of employed people among those who are above 45 years of age is much lower than in the younger age groups - in 2008 it amounted to 56.5% (ONLINE http://www.stat.gov.pl). The low employment rate of the elderly is a further indication in terms of undertaking ergonomic measures for the elderly.

5. Ergonomics of the elderly and the disabled

The task of ergonomics is to match the technical environment to the psycho-physical needs of the users. This is particularly important in the case of the elderly and the disabled, whose adaptive capacities are reduced, however, ergonomic measures are not limited to enabling a specific user to use the technical object, but also create conditions for an optimal (comfortable and effective) use of a technical object (Misztal A., Butlewski M., 2012). Achieving this goal usually requires an extensive knowledge not only in the field of design, but also on the topic of the needs of different user groups, which are to some extent antagonistic requirements (Butlewski M., 2012).

Due to the high correlation of ergonomic criteria for the design for the elderly with the design requirements for the disabled, and many similarities shared by the two groups mentioned above, it is suitable to refer to other publications in this area, which include the principles of shaping the environment of people with disabilities from simple hand tools (Butlewski M., 2012) and public facilities (Butlewski M., Tytyk E., 2009) to the universal principles of design (Branowski B., Zablocki M., 2006). Analyzing the scope of activities in the area of ergonomics for the elderly and the disabled, measures can be separated by their goals:

- adaptation of existing technical objects for the limited functions of people who use them,
- design of medical and rehabilitation equipment,
- analysis of the modes of action of the elderly and the disabled, and an assessment of their ergonomic correctness,
- analysis of the actions of the “helpers” of the elderly in terms of ergonomic loads (doctors, rehabilitation therapists, caretakers),
- methodologies for the development of the environment of the elderly and the disabled, including the development of standards and (computer) tools supporting ergonomic design.

The latter group includes solutions for modeling situations involving persons with reduced abilities through the use of computer aided design (CAD) methods. Data in the form of ranges and force at each specific position of the motion segment are integrated in computer models (Branowski B., Pacholski L., Rychlik M., Zablocki M., Pohl P., 2013).

Adapting ergonomic requirements for people with disabilities, it can be assumed that a properly ergonomically designed working environment for elderly people should fulfill the following functions (based on Paszkowicz M. A., 2009, p. 278):

- enables and facilitates the functioning of the user in his or her chosen dimension and scope,
- corrects imperfections and user errors,
- mitigates the arising effects of hazardous events,
- prevents the advancement of disability and rehabilitation,
- helps other people in the care of the elderly and the disabled,
- provides savings and high efficiency (no loss),
- ensures enjoyment while using the specified object.

It should be noted, however, that the adjustments and work on the ergonomics of workstations are of particular importance with the assumption that only a fully engaged worker allows for the success of the organization that employs him or her (Golaś H., Mazur A., 2008).

Ergonomic measures also serve to utilize the specialized skills of elderly people, which are lacking in younger people. Because despite the mentioned limitations of the elderly that are increasing with age, it should be noted that, according to literature, elderly people in many aspects are better workers than younger people. The features that positively distinguish elderly people in the workplace are (Jasiak A., Misztal A., 2004):

- greater awareness of the duties and responsibilities,
- reduced staff turnover - greater commitment to the company,
– richer experience which generally supports a greater knowledge,
– strong interest in their work,
– less susceptible to accidents at work, due to caution acquired with age.

The utilization and dissemination of these advantages can allow to increase the interest in older workers of employers.

Understanding the limitations of elderly people allows the creation of rules for preparing working positions tailored to the ergonomic requirements for this particular group of people. Taking into account the simultaneously associated with old age disability reveals the following key principles for employers of shaping work positions for the elderly (based on Jasiak A., Misztal A., 2004):

1. Should not employ in work which will further unduly burden the impaired, due to age or disability, human body parts or organs that compensate them,
2. Should not employ in work where there is a high risk of committing an error resulting in tragic consequences (work at heights, handling heavy machinery, etc.),
3. Should not employ in heavy physical work; workers should especially avoid long-term loads, as well as local loads overburdening regionally e.g. part of the musculoskeletal system even if it does not have a limited efficiency,
4. Should not employ in work carried out on a project-based employment or in work done at a forced pace,
5. Should not employ in work requiring extremely fast and precise movements and a very good visual - motor coordination,
6. Should provide adequate visual comfort, and therefore an increased level of light intensity, at the same time with the absence of glare,
7. Should provide comfort in terms of the microclimate conditions, particularly the temperature and humidity - avoid extreme temperatures, which greatly burden the elderly,
8. Should use signals of an enhanced intensity, in order to increase the probability of their accurate reception, in a suitable interval of time, and in an unambiguous manner; in the case of sensory deficits should use several kinds of stimuli to relay the same information,
9. Should limit the amount of jobs that require a significant and unnecessary burden on mental alertness including the need for focused attention and for short-term memory of a variety of information.

A portion of the above listed rules are very general in nature and do not take account of specific cases and the working environment.

Figure 2 shows an example of a solution that meets the ergonomic qualities of a solution supporting elderly - disabled people in terms of movement. An appropriately shaped seat allows for movement without burdening the body with forward bending during sitting. The use of such a built robot allows an elderly person to navigate and perform tasks including work without creating unnecessary burdens for the musculoskeletal system, as is the case with the wheelchair for people with disabilities.

6. Conclusion

The recent demographic changes mean that work for the elderly and in a large portion the disabled will be a necessity, and also an opportunity for personal and social development. It is therefore necessary to create mechanisms and tools for the implementation of work in good conditions, which not only does not impair, but also allows for physiological, social, and economic development. The tool to accomplish this is ergonomics, which through its methods may lead to an increase in employment of elderly people and those not fully able, who for various reasons are currently unattractive in the labor market. Naturally, this effect is not achieved only by improving the content and conditions of work, but also through the use of innovative solutions in the field of work organization, even such as work (job) sharing (Kawecka-Endler A., 2012). The issues presented in this publication are interdisciplinary and describing them from only one perspective seems unreasonable. However, according to the author's opinion, the relationships presented fit well with the trend of systematic thinking and are associated with a relatively new concept of study called macroergonomics (Pacholski L., 1995). The justification for this type of perception of issues related to the work of the elderly is also due to the fact that it has a character which connects aspects from related disciplines such as sociology, economics, politics, culture, ecology. This approach can provide a more efficient use of available resources by elderly people with disabilities and can reduce the stress of the inevitable aging of every human being.

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