



PRODUCT DEVELOPMENT FOCUSED ON PEOPLE WITH SPECIAL NEEDS

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Abstract: Persons with special needs express special requirements towards products and services in order to maintain or improve the quality of their life in means of reasonable costs for the individual as well as for the society. Elderly people form a continuously expanding group of the special needed, the development of products that meet their requirements being one of the major preoccupations not only of the manufacturing companies but of the entire society. Technical requirements of a product are affected by the constraints resulted from the special needs expressed by these persons. This paper contains an argumentative introductory part based on which further it also proposes an algorithm for product development in order to meet the requirements of the old persons. A theoretical case study highlights the effect of elders' special needs on the product development process.

Key words: product, people with special needs

1. INTRODUCTION

1.1. People with special needs

In 2001 the World Health Organization (WHO) elaborated a multidimensional (bio-psycho-social) and multidirectional classification system, the International Classification of Functioning, Disability and Health-2 (ICFDH-2). This definition resulted from the fact that several disablement definitions and models were developed during the years, differing from each other mostly in the per cent of social, medical, legal, historical or philosophical influences.

The new (ICFDH-2) provides a classification of all people, not just of those categorized by an acknowledged diagnosis. Instead, it addresses disability as a dynamic condition, being an interaction between personal abilities, environmental and personal factors [1].

1.2. Elders as a continuously expanding group of people with special needs

The aging of population is a process, which takes place at international level, thus the most affected countries being the so-called “newly

industrialized” and the rapidly developing regions [2]. The outstanding evolution of medical sciences and technologies, besides the massive reductions of fertility influenced the demographic structure of the 21st century in an unprecedented way. In most of the developed countries the number of elders exceeded the number of children for the first time in 1998, while at world level this is expected to occur in 2045. In the year 2000 the number of elders was of 600 million, in 2009 over 700 million and in the next 40 years it's projected to reach the 2 billion [2].

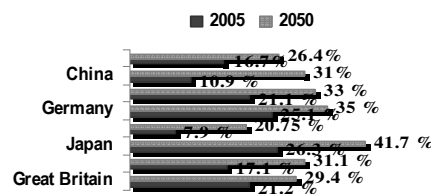


Figure 1. Expected percentage increase of people aged 60 and over in 2050 reported to 2005 [3]
The aging phenomenon is characteristic not only for the population as a whole, but also for

the population of the elders. This group of the society can be divided into two categories: the youngest olds, aged 60-80 years, and the oldest olds, those aged 80 and over, the latter one being the fastest growing, increasing with 4.0% each year. Based on current statistics, by 2050 the number of oldest olds is expected to rise to 1 per every 5 old people [2].

Population aging has major impact and consequences in all life areas, the two most affected being the economic and the social sphere. "A decrease in the number of working population leads to a negative outcome regarding economic growth, savings, investments, consumption, labour market, pensions, taxation and intergenerational transfers. In the social sphere population aging influences family composition and living arrangements, housing demand, migration trends, epidemiology and the need for healthcare services" [4].

Integrating the elders in the society, providing them the possibility of an individual living, represents a possible response to some of the previously mentioned situations. The elders' welfare, independence and positive attitude towards participating actively in the social and economic development of the population calls

for special recognition, as they express particular age-related vulnerability and frailty.

1.3. Special needs of the aging population

The human body goes through several changes during the aging process, starting with the most visible part, the skin, to all the members and internal organs. An increasing body of evidence shows that due to the chronic diseases, vision, hearing, strength, memory, dexterity and mobility changes related to age, old individuals find it more challenging to complete individually certain tasks and daily routines, having an increased need for support, usually offered by family or specialized assistance [5]. Statistics highlight that 88% of American elders have at least one chronic disease [8] which appear besides frailty, which is known as the leading effect of aging. The following table summarizes and categorizes the disablements occurred due to the so called „*healthy-aging*” or „*successful aging*”, impairments which in many cases are not singular, frequently appearing simultaneously with several other diseases that may not represent a threat to a young body but may provoke major complications to a seniors' health condition.

Table 1. Table 1. „*Healthy - aging*” related impairments

DETERIORATION OF...	MAIN CAUSES	RESULTED IMPAIRMENTS	PREVALENCE AMONG THE ELDERS
Vision	- corneal flattening - cataracts (lens transparency disorder) - reduced retinal efficiency - presbyopia (crystalline lens becomes thicker and less sensitive)	- difficulties in seeing clearly close objects clouded, blurred vision, sensitivity to light and glare, double vision in a single eye - difficulties in spatial and black-white contrast perception - decreased focusing ability to near objects, eyestrain, headache	- there are 285 million visually impaired persons globally (65% over 50 years). 246 million have low vision (63% over 50) and 39 million are estimated to be blind (82% over 50) [7].
Hearing	- tinnitus (perception of sound within the ear in the absence of a corresponding external sound) - presbycusis	- mental confusion, stress - loss of ability to hear high frequency sounds such as consonants t, p, k, f [2]	- 20% of person between 65-74 years, 50% of those over 75 years[9]
Musculoskeletal system	- vertebral compression, increased knee and hip bending, loss of muscle strength and quality	- limited range of movements, decreased length and speed of footstep, change of footstep typology, reduced flexion degree	- among 7,9 million elders from USA 12,9% present mobility

	rheumatologic diseases structural deterioration of bones	of knee and ankle, predisposition to falls - difficulties in standing up from bed, chair, maintaining balance - predisposition to fractures	impairments[10] - 40% of old individuals die of heart disease and 15% of strokes [8]
Cardiovascular system	- changes in the structures of cardiac tissue, in the conduction system and coronal arteries; blood vessels lose their elasticity, their walls get thicker [6]	- development of aneurysms (affects vision), of thrombosis, varices, hypertension, coronary heart disease and heart attack. The heart is affected directly, responding more slowly to sudden movements, causing dizziness and balance loss [4]	
Nervous system	- the brain and spinal cord lose nerve cells and weight	- difficulties of language (when using uncommon words), maintaining the concentration level, reduced or lost reflexes leading to problems with movement and safety etc.	

2. PRODUCT DEVELOPMENT FOR PEOPLE WITH SPECIAL NEEDS

2.1. New approaches to product development

Increased life expectancy and implicitly the expanding group of potentially more dependent people, opens new market niches and generates new opportunities regarding product development. People older than 50 years have more than a half of Germany's spending power and assets, they buy more than 45 % of all new cars, 50 % of skin care products and they book about 35 % of holiday packages [11]. Nevertheless, seniors face several usability issues regarding new technology, prohibiting them in fundamental activities **Figure 2**.

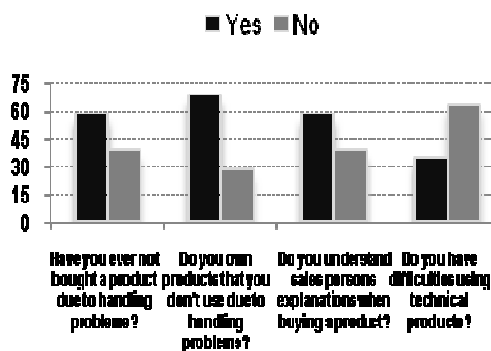


Figure 2. Use of technical devices among elders (in %) [11]

A continuously increasing number of policies tend to regulate the development of products for this group of the population, lately referring to and including universal design guidelines simultaneously to accessible design best practices.

Universal design is an ideology expanding from the USA starting from the '70, better known in Europe under the name of Inclusive design, Design for all or Lifespan design. Promotes usability by as wide range of people as possible, without any adaptation. [12].

Advocates of *universal design* established 7 central principles of this ideology, which offer a solid basis for product designers:

1. **Equitable Use:** The design does not disadvantage or stigmatize any group of users.
2. **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.
3. **Simple, Intuitive Use:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. **Perceptible Information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

5. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Low Physical Effort: The design can be used efficiently and comfortably, and with a minimum of fatigue.
7. Size and Space for Approach & Use: Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility [12].

The next figure represents the effect of universal design upon the ability/disability gap existing between persons and their personal capabilities and different requirements of the environment [13].

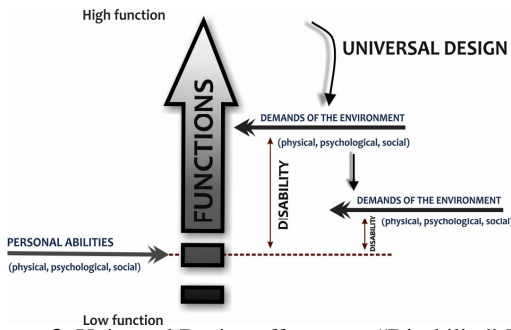


Figure 3. Universal Design effect upon “Disability” [13]

Universal design can be considered an umbrella term, expressing in a more comprehensive manner the more widely known *Design for X* principles and guidelines regarding products for people with special needs, such as design for accessibility [14], usability [15], ergonomics, adaptability, safety etc.

Besides these ideologies product development for the aging population is influenced by a range of paradigms and strategies which need to be addressed, paid permanent attention to and built in the new product development models in order to design products which meet the needs of the clients, and satisfy the requirements of all the other stakeholders.

2.2. New product development models

New Product Development (NPD) models changed gradually in the past few decades, passing from production-centralized to client-driven ones. It is indeed an understandable

process, since in the highly globalized and competitive market, manufacturing companies base on three important criteria: customer satisfaction, shorter time to market and lower production costs.

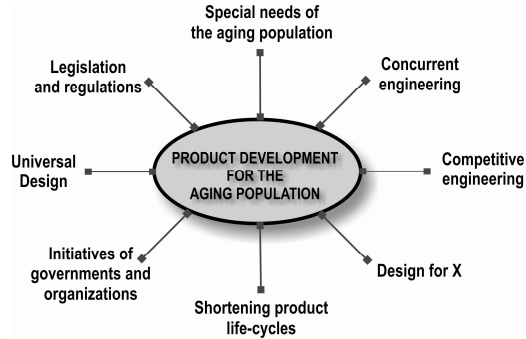


Figure 4. Influences on product development for the aging population

Identifying the clients’ needs, associating the product design attributes in order to meet these needs and through them gaining customer satisfaction, „would ensure sustained customer loyalty and competitiveness to the firm”[16]. The „conventional” NPD process includes eight major steps, which may alter, disappear or be completed with others, depending on the profile of the engaged company:

1. Idea generation
2. Idea screening
3. Concept development and testing
4. Marketing strategy
5. Business analysis
6. Product development
7. Test marketing
8. Commercialization

There does not exist one single and right product development process for a number of firms. Each company has to identify at first point its strategic orientation among the six existing ones: Time to market, Low product cost, Low development cost, Product performance, technology and innovation, Quality, reliability, robustness, Service, responsiveness and flexibility in order to correctly approach a NPD process.

Design for Six Sigma [17], Stage-Gate model, Quality Function Deployment and Flexible Product Development are the most used NPD strategies among the manufacturing firms. Studies (Product Development & Management Association, AMR Research, Booz-Allen Hamilton) show that among US leading companies the use of Stage-Gate model has a

prevalence of 70-85% and it is also considered worldwide an industry best practice.

However including the requirements of people with special needs and the existing regulation do not change the models of product development, they influence the course of it by amplifying the idea generation and idea screening phases.

3. CASE STUDY

In order to highlight the effects of constraints resulting from requirements expressed by those with special needs, a theoretical case study was conducted regarding the design of a mobile telephone for two target groups: the so-called “normal” people and the elders on the other hand. The chosen product development model is one of the Design for Six Sigma (DFSS) approaches, the DMADV (Define-Measure-Analyse-Design-Verify), which is widely used for weather developing a new product or optimizing an existing one. The software used for the present case study is Qualica Planning Suite.

The first step, Define, implies an establishment of the targets, risk factors, main timelines for the engaged activities and the financial budget in order to have a well-defined reference range for the future decisions.

The Measure step requires a detailed analysis of the customers in order to identify and understand their needs. The VOC (Voice of Customer) is a proper tool for a more detailed understanding of the meaning of each expressed need, transforming the voice of the customer into demands. Starting from a given set of basic and common needs of both groups (normal persons and elders) expressed towards the studied product, an AHP (Analytic Hierarchy Process) analysis was performed for building a hierarchy among identified requirements:

1. Possibility to communicate
2. Easy to use
3. To be portable

When completing the set of initial needs with the regulations given by standards and by the impairments that elders face, a series of

constraints show up. ISO 20282-1:2006, ISO/TR 22411:2008 provides requirements and recommendations for the design of easy-to-operate everyday products for the European market, but there are also other regulations that can be taken into consideration.

Hearing impairments require the possibility to raise the volume of the speaker, or the possibility to contact the phone to a hearing aid. Regarding visual impairments, a proper font display, and contrast rate should be taken in consideration. Due to impairments resulting from cognitive and memory insufficiencies, the elders use more easily a mobile phone if only the basic functions are present. Considering the prevalence of frailty and chronic diseases, an emergency button can be added, offering the possibility to contact family members or hospital emergency department. Larger buttons address low dexterity and mild mobility impairments.

Starting from this point the algorithm follows two different paths **Figure 5**. The upper wing represents the track for mobile phone design for the elders, the lower one is for normal persons. As DMADV is mainly based on a 4Phase QFD (Quality Function Deployment), later on is applied for quantifying and correlating customer needs with technical requirements of the product. In the Analyze phase of the DMADV another distinguishing process appears. In order to apply the 2nd phase of the QFD, product functions have to be identified. Special guidelines as Universal design, Design for ergonomics, Design for usability, Design for adaptability influence a product functions determination.

In the design step the product details are defined. The last phase of the project is Verify, which assures that technical characteristics of the product offer the proposed quality in the Define phase, in the determined budget limits and reliability parameters. These last two phases were not treated in detail in this case study, as the development process does not change; the stages are continued similarly in accordance with the identified technical characteristics.

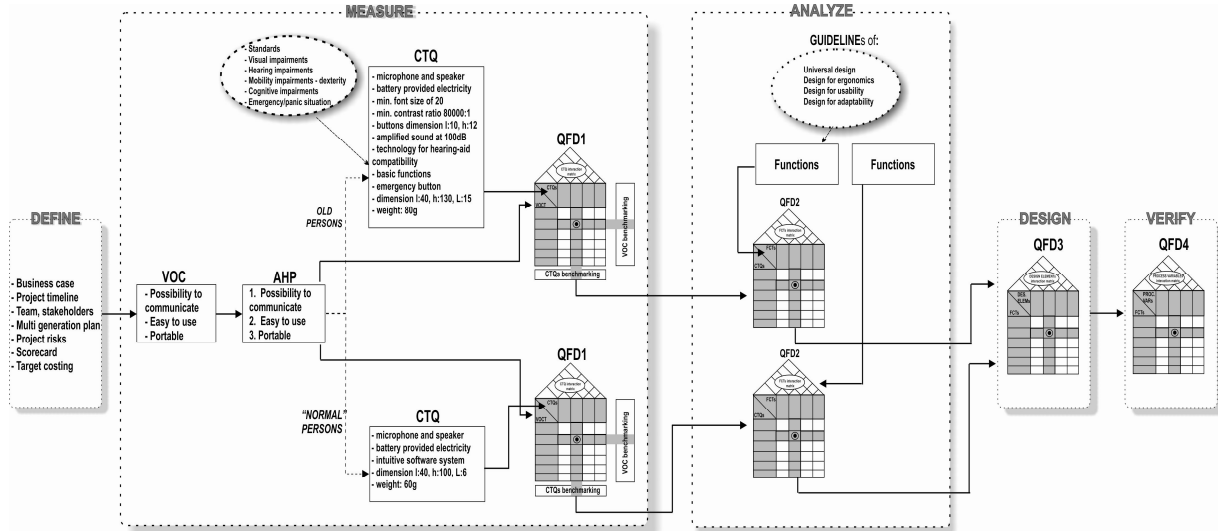


Figure 5. The influence of elders' special needs on product development

4. CONCLUSIONS

Elders form a continuously enlarging group of the population, showing special needs regarding products and services. Addressing and fulfilling their needs for a continuous improvement of the quality of their lives calls for special undertakings of the manufacturing companies.

This paper highlights through a suggestive algorithm that a major differentiation between product development for normal people and for seniors can be perceived at the first stages of the process. Competitive and concurrent engineering tools can be successfully used in order to develop products for this segment of society.

Future work is going to be conducted for developing a complete product development methodology for designing correctly products that meet the needs of people with special needs and all the other stakeholders.

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Dezvoltare de produs pentru persoane cu nevoi speciale

Rezumat: Persoanele cu nevoi speciale exprimă cerințe speciale la adresa produselor sau serviciilor cu scopul de a-și menține sau îmbunătăți calitatea vieții cu costuri rezonabile, atât pentru aceștia, cât și pentru societate. Persoanele vârstnice formează un grup în continuă creștere al persoanelor cu nevoi speciale, dezvoltarea de produse care să răspundă cerințelor acestora fiind una dintre preocupările majore ale producătorilor. Caracteristicile tehnice ale produselor sunt influențate de limitările și constrângerile impuse de cerințele specifice exprimate de această categorie de persoane. În prima parte a lucrării sunt detaliate argumentele teoretice pe baza cărora a fost elaborat algoritmul de dezvoltare de produs pentru persoanele vârstnice, prezentat în lucrare. Efectele pe care nevoile speciale le au asupra procesului de dezvoltare de produs sunt evidențiate pe baza unui studiu de caz teoretic.

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