

# The Relationship Between Housing Accessibility and Healthy Aging: The Case of Turkish Elderly Women

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**Abstract.** This study proposed Importance-Performance Analysis (IPA) as a tool to elicitate the requirements of elderly to age well and improve the accessibility of home environments. It aims to address the accessibility issues in a case housing environment and provide guidance and design recommendations to designers and architects, who generally have difficulty to obtain information on universally designed housing environments. First, healthy aging concept is introduced. Then, the role of housing accessibility in healthy aging is explored. Later, the methodology is presented. In the findings the importance and satisfaction ratings of 100 Turkish elderly women, which are selected from an exemplary housing environment of the most dense and busiest urban area in Ankara, are analysed. According to results, IPA could be an effective tool to decide how to meet accessibility requirements and maximize home satisfaction. Thus, this study contributes to the design literature by being a first study to explore the applicability of IPA technique in design discipline while eliciting elderly women expectations and accessibility requirements for healthy aging.

**Keywords.** Accessibility, importance-performance analysis (IPA), home environments, elderly

## 1. Introduction

Housing environments are the essential part of city life to maximise independence and the full participation of all people in all aspects of society. However, due to the increasing urbanization, changes in housing technologies and rapid growth of cities, the user-friendly nature of houses are disappearing. Homes become more fragmented, which causes separation of people from each other and their ecological place. These changes in physical and social structure of houses lead to the lack of a universal platform for self-fulfilment and individual dignity, especially for elderly women. From the user perspective, in most of the cities in Turkey the physical configuration of houses and the social development process are not universal and sustainable, but rather are problematical for both disabled and non-disabled elderly people to age well. From the designer perspective, there is a lack of knowledge on universal design and how to

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implement its principles. Therefore, this study aims to address the accessibility issues in a case housing environment and to provide guidance to designers and architects, who generally have difficulty to obtain information on universally designed housing environments. Its contribution to scientific knowledge is to treat housing accessibility as a design response to eliminate social exclusion of elderly women in housing environments, achieve a sustainable performance within houses, produce better homes, increase user satisfaction and achieve healthy aging.

## **2. What is healthy aging?**

World Health Organization (WHO) and Help the Aged use the age of 60 years as the start of aging process, where as UK Office of National Statistics and Age Concern refers older people as those aged 50 years and over [1]. In Turkey, old age is defined as the age of 65 years and over. According to Walford and Kurek [2], however, using the term 'old' and/or 'elderly' could be sometimes discriminatory and cause misunderstandings that those people are regarded as frail. Nevertheless, aging process has effects on people's functional (strength, mobility, sensory) and mental abilities (dementia).

World Health Organization (WHO) defined health as a 'state of being complete physical, mental and social well-being, and not merely the absence of disease or handicap' [3]. Based on this definition, body components, function and structure are interrelated with activity and participation. Within this interrelationship, both environmental and personal factors have a key role and should be adequate to achieve independence [4,5]. Since older people, especially older women, performed most of their daily activities at home, independence at home has close relationship to healthy aging. According to WHO (2001), independence at home means to execute a task as a part of daily routines by an individual. Therefore, barriers in the physical environment of homes cause problems in functional capacity of older people [6-9]. Theories of environmental gerontology highlight the significance of a stable equilibrium between personal competence and environmental barriers [10-12]. However, in old age, this equilibrium is not stable, which requires researcher to consider the person-environment fit while maintaining healthy aging in very old age at home. Therefore, there is a significant amount of progress on design for elderly people. According to Newell and Monk [13], the new challenge is to ensure that new generations of elderly people are fully included and integrated in built environments. As a response, lifetime home concept was developed in the early 1990s by Joseph Rowntree Foundation [14], which was based on the principles of making homes accessible for everyone and offering flexibility and adaptability to meet user's aging needs throughout their life. Since the quality of home environment influences user physical and mental well being in later ages [15], home is not only a container of well-being and a place of security, but also a space for self-identity for older people while engaging in daily life. As people age, they spend 80% of their time at home [16]. Thus, for the purpose of enhancing their performance at home, accessibility and usability become essential [17]. Promoting health within an accessible user-home environment should be an integral part of life.

### 3. The role of housing accessibility in healthy aging

As mentioned earlier, the physical configuration of the built environment as an important source of social inclusion generates a number of reasons to adopt accessibility, which has benefits to everyone [18]. In this study, accessibility is defined as the extent to which the elderly people are enabled to visit, reach, use and access all the home facilities regardless their ability [1]. According to Gabriel and Bowling [19], one of the central dimensions of the quality in later life is offering access to facilities and services in a neighbourhood. An accessible route of travel is the key unifying element that facilitates the safe and independent use of a site and its buildings by all people ...connects site arrival points, i.e. parking, bus stops, etc., with all exterior and interior amenities [20].

According to Handy et al. [21], people are more active in accessible built environments. Although the research of physical environment on older adults began in the 1960s [22], due to the increasing urbanization, changes in the construction technologies and rapid growth of cities, the user-friendly nature of buildings is disappearing. Older people are coping with aging related stress, social isolation and loneliness. Unsuccessful adaptations of homes, living in homes with physical barriers and lack of correct housing decisions in later life will result in serious health and social consequences, such as falls and dependence on others to perform daily activities [23]. Falls at home are estimated to account for 40% of the lifetime injury costs for older women, and Compared to men, being an old female is significantly associated with home injurious falls [24]. Additionally, fall risks are mostly increased because of inaccessible features, functional impairments (e.g., limitations in daily living activities) and physical limitations (e.g., bending knees) so that these limitations make difficult to perform regular everyday activities. Thus, according to UN [25], accessibility at homes is vital to support elderly women living not only independently but also healthy throughout the whole lifecycle.

Reviewing the literature showed that researches developed methods, checklists, instruments to meet the requirements of elderly people for a safe, accessible and functional environment and to guide designers [26]. Iwarsson and Slaug [27] developed housing enabler instrument to explore functional limitations of older people and their demands. Later, Carlsson et al. [28] further developed housing enabler to include accessibility requirements. Imrie [18] stated that universal design is a primary mechanism to design accessible environments not only for older people but also all people regardless of age, size and ability. Herssens, Nijs and Froyen [29] also referred to universal design approach to minimize the need for personal assistance and support adaptable living with comfort in later ages. The concept of universal design was first used in 1970's and reinterpreted by the American architect Ronald Mace in 1985. Since then, it has become a widely accepted design approach that is also known as, 'inclusive design', and 'design for all'. Universal design has seven principles that yield accessible, adaptable and affordable spatial environments for all: P1. Equitable to use; P2. Flexibility in use; P3. Simple and intuitive use; P4. Perceptible Information; P5. Tolerance for error; P6. Low physical effort; P7. Size and space for approach and use [30]. However, in practice designers, policy makers and constructors have a lack of critical knowledge of universal design, accessibility regulations, or they find difficult to apply these standards [29]. For these reasons, this study investigates accessibility needs of elderly women in relation to their existing home performance, and as a result, it provides an importance-performance matrix to be used as a guide in architectural design process for healthy aging in home environments.

## 4. Method

### 4.1. Sample

90 Turkish elderly women between the ages 65-95 (with a mean age of 74.8) were chosen by random sampling in urban areas with the same income level in Ankara, Turkey. 90 occupants from the apartment dwelling type participated in this eight-week field study from mid-July to mid-September 2017. Apartment dwelling type is very common housing typology in Turkey. Those dwellings are mostly six to eight storey heights and composed of four to three flats in one story. The flats are generally composed of one living and three bedrooms with approximately 100-120 m<sup>2</sup>. In the study, it is used to be 61% of the participants do not have any health problems, whereas 9% pointed out eye problems, such as low vision, cataract etc. 30% reported mild movement problems, such as rheumatism etc.

### 4.2. Construction of the instrument and data collection

Based on the literature review above, a survey instrument was developed to explore accessibility at home under the three main areas (approach to home, access inside the home, and access to key facilities) with two sets of 34 questions. The first set was composed of 34 accessibility importance questions, which were used to rate participants' importance level for each question item on a scale of 1-5, (1 being the least important and 5 the most important) and to identify how important is each of accessibility item in an home environment. Second set was also composed of the same 34 questions with same Likert scale, but in this set participants were asked to rate their own home's accessibility performance level for each question item on the same scale of 1-5, (1 being very dissatisfied and 5 very satisfied). The study was approved by the Ethics Committee, Bilkent University, Turkey.

Content validity of the instrument was done with an expert panel. The expert panel consisted of 16 persons all over the world from academia; six professors from architecture, two professors from industrial design, one professor from interior architecture, four associate professors from behavioural and technical sciences, two occupational therapists and one doctor of medical science. A two round revision session was conducted with these experts. A moderator different than the author had coordinated both sessions. The alpha coefficient for the final 34 item was 0.8721, suggesting that the items have relatively high internal consistency.

All the participants were visited at their own home environment, and the data were collected during face-to-face surveys. At the beginning, a brief summary of the procedure and the aim of the study were explained. The items that may not have been clear to participants were explained as a part of questionnaire. Further information was obtained through an unstructured interview, which helped to discuss the results of the questionnaire in a more comprehensive way. Further, to avoid any biases, there was a 10 minute break after importance questions to conduct the performance part.

### 4.3. Data analysis method

To analyse the data, first exploratory factor analysis was conducted. Later, factor attributes were assessed by the importance-performance analysis (IPA). IPA was used as

an analytical technique, which is considered an effective tool to set priorities on two dimensions; the importance and the performance (satisfaction level). IPA was originally introduced by Martilla and James [31] to provide insights to service attributes in firms to achieve customer satisfactions. The means of importance and performance are divided in a matrix of four quadrants (Figure 1). First quadrant includes attributes with high importance and satisfaction, which refers to sustaining the competitive advantage. In the second quadrant, there are attributes with high importance but low satisfaction, which refers to an immediate attention [31]. Quadrant three includes attributes of low importance and satisfaction. It is not necessary to have additional effort with those attributes. Quadrant four is rated as low importance but high satisfaction, which implies that resources for these attributes would be used elsewhere.

<b>Attribute performance (satisfaction)</b>	Quadrant IV Low importance/High satisfaction	Quadrant I High importance/High satisfaction
	Quadrant III Low importance/Low satisfaction	Quadrant II High Importance/ Low Satisfaction
	<b>Low</b>	<b>High</b>
	<b>Attribute importance</b>	

**Figure 1.** Importance performance analysis (IPA) matrix with four quadrants.

According to Sampson and Showalter [32], IPA has been used in a variety of settings, especially in hospitality and tourism research for years [33], leisure [34], education [35] and healthcare [36]. However, as far as the study examined, IPA has not been used in interior architecture context, which is a multi-parameter task and requires identifying a set of priorities to satisfy changing user needs, demands and expectations in buildings. In the study, IPA has been suggested as an effective tool to decide how to best meet accessibility requirements in order to maximize home satisfaction, which is closely and directly linked healthy aging. Thus, this study contributes to the design literature by being a first study to explore the applicability of IPA technique in design discipline while eliciting older women expectations and accessibility requirements for healthy aging.

## 5. Result and Discussion

### 5.1. Factor Analysis: Development of Healthy Aging Factors

Before carrying out factor analysis, firstly the survey instrument is checked whether there are any items at the extreme ends (floor and/or ceiling effects). Since the used scale in the study is 5, items below 1.5 and above 4.5 are regarded as extreme ends. There were no items at the extreme ends. Pearson product-moment correlations of the response scores were calculated and a correlation matrix was constructed. Total variance of factors was calculated. In this respect, factor analysis resulted in a four-factor solution that accounted for 59.835% of the total variance, 34 items had 59.835% variances in common, so they correlated highly with four common themes; each theme was considered to be a factor scale (Table 1).

**Table 1.** Total variance explained.

Factor	Scale	Eigenvalue	Variance	Cumulative
1	Adequate circulation expectations	8.041	22.371	18.043
2	Ease of reach to services	3.698	10.978	27.930
3	Comfortable floor space	1.990	6.451	44.778
4	Adequate illumination	1.537	5.002	59.835

The universal design meanings assigned to the four factors in terms of healthy aging are explained below:

1. Factor 1, 'adequate circulation expectations' is defined as equitable and simple use of the corridors inside the home and short distances from either car parking and/or bus stop. The appropriate size and spaces are as important as ease of use of circulation elements to maximize their legibility. Adequate circulation contributes accessibility by corresponding to the cognitive demands of diverse people. Different than the other countries, in Turkey kitchens are still used mostly by women. Thus, this factor is also concerned with the provision of clear widths between kitchen unit fronts/appliance fronts. Moreover, attributes of this factor also include a safe route from entrance to rooms and entering to rooms without steps, which are the most essential design considerations in independent daily living in later life.

2. Factor 2, 'ease of reach to services', deals with the accessibility issue of all kitchen cabinet components and their comfortable and equitable use for any seated or standing user with low physical effort. Ease of reach to all electrical outlets should be considered not only in later life, but also throughout the whole life. Furthermore, any level changes can create barriers for ease of reach and should be avoided or replaced by gentle slopes, particularly while approaching to home.

3. Factor 3, 'comfortable floor space', is defined by being used with low physical effort and safety. Comfort in home environments can be achieved with lighting, non-slippery floor surfaces and convenient movement between rooms. Concerning aspects of comfortable floor space, physical aspects of home environments, particularly sizes of rooms as well as numbers of rooms are closely related to the spatial layout of home

interiors and furniture. All components' of bath services should be designed with a comfortable frontal and side approach zone.

4. Factor 4, 'Adequate illumination', is defined as the provision of perceptible information. Home interiors should have tonal contrasts against surroundings and help elderly people regardless their ability to understand where they are and to guide them in which way they need to go. Legible spaces with tonal contrasts, daylight and tactile surfaces are easy to navigate. Especially, visually impaired elderly, whose orientation and way finding abilities decrease with age, prefer well-connected spaces with clear daylight views. Thus, adequate illumination could improve elderly performance, health and wellness in home environments, while carrying daily activities.

### 5.2. Importance-performance analysis (IPA) of Healthy Aging Factors

Having obtained healthy aging factors, the mean values of importance and satisfaction performance of each factor attribute were calculated. Table 2 lists the mean rankings of these attributes. According to the IPA approach, importance-performance matrix was constructed. Figure 2 depicts the IPA matrix. The means have split the axes.

**Table 2.** Mean ranking of the importance and satisfaction performance attributes of healthy aging factors.

No	Attributes	Importance Mean	Performance Mean
1	A short distance from parking space/bus stop to the main entrance.	4,06	2,97
2	A comfortable route to the main entrance.	4,19	2,16
7	Room entrances without steps.	4,51	2,45
19	Provision of clear widths between kitchen unit fronts/appliance fronts.	3,31	4,32
29	A safe route from entrance to rooms (if more than one story).	2,27	4,56
28	Effective clear width of hallway/stairs (if more than one story).	3,97	4,40
4	An accessible entrance without steps.	4,88	3,10
20	Ease of reach to all below cabinet components comfortable for any seated or standing user	4,21	2,90
26	Ease of reach to all electrical outlets	4,34	2,07
21	Ease of reach to all above cabinet components comfortable for any seated or standing user	4,65	2,60
14	Provision of a comfortable frontal and side approach zone for each sanitary ware.	4,01	2,71
5	Convenient movement between rooms	4,31	3,21
9	Non-slippery floor material in rooms	4,26	2,80
22	Adequate illumination inside of kitchen cabinets	3,86	2,79
6	Adequate illumination in rooms	4,81	1,91
3	Adequate illumination while approaching to the main entrance.	2,05	4,50

Quadrant I (high importance, high performance): In this quadrant, there are eleven attributes. Their existing home environment ensures that the accessibility of their home keeps up good work on these attributes.

Quadrant II (high importance, low performance): A comfortable route to the main entrance, ease of reach to all electrical outlets and adequate illumination of rooms are

attributes that elderly give high importance, but these three attributes are in low performance in their existing homes, so they should be improved based on accessibility and universal design principles to age well. Therefore, special attention should be given on these three attributes to meet the expectations of the elderly.

Quadrant III (low priority, low performance): There are no attributes in this quadrant.

Quadrant IV (low importance, high performance): Adequate illumination while approaching and a safe route from entrance to rooms are viewed as areas that elderly do not give importance, but their existing home performs well concerning these two attributes.

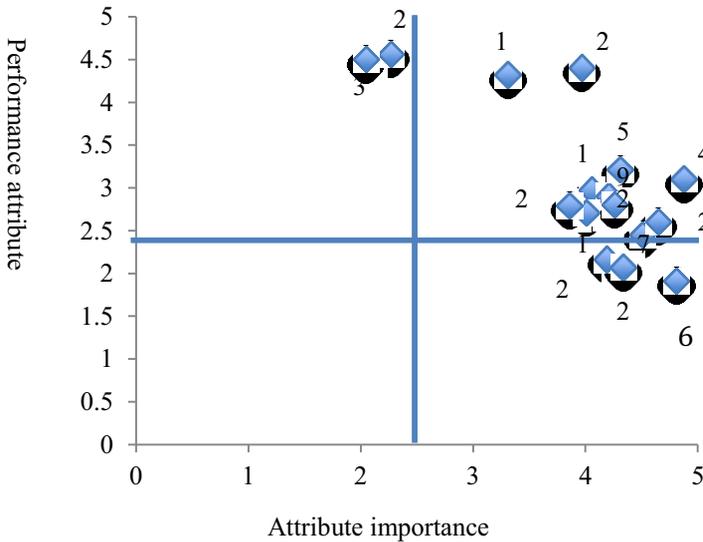


Figure 2. IPA matrix of importance-performance analysis.

### 6. Conclusion

These studies proposed IPA as a tool to elicitate the requirements for elderly to age well and improve the accessibility of the home environments. Since findings from studies on everyday life in old age showed that elderly people spend more time at home than younger people do, a universally designed home environment become very important in old age despite functional limitations and accessibility problems. Although most of the studies reported the possible link between housing accessibility and independence in daily activities in old age, still there is a lack of information about the critical set of housing accessibility attributes and their comparison regarding importance and performance of these same attributes. Finally, this study defined housing accessibility as a design response to achieve a sustainable performance and increase home satisfaction for achieving healthy aging. The typical homes in Turkey and the typical apartment living typology need to be improved. During this improvement process, the proposed IPA tool could be a promising method to elicit elderly needs based on both satisfaction

and importance priorities. This tool highlighted the importance of prioritization process for positive aging. The results of this study also identified key lessons for Turkish apartment planning and apartment renovation policies. The apartment construction sector could implement this IPA tool while constructing elderly-friendly new homes.

The implications of the study could be summarized as follows:

(1) *Housing satisfaction*: Since 1960, housing satisfaction is defined as the classic measurement of the perceived quality of the home. However, as highlighted in this study, home satisfaction in later life is a complex and multi-parameter issue, which needs to be prioritized based on the importance ranking of elderly people. It is mostly based on the cognitive assessment of elderly people on the person-environment fit of their own home environment.

(2) *Accessibility at home*: Both accessibility and usability in home environments are mostly concerned with the functionality and capacity of the physical environment to perform necessary activities. However, IPA in this study explored that although an attribute is essential for accessibility, it could be ranked under low importance category, such as adequate illumination while approaching and a safe route from entrance to rooms. Thus, it should be questioned by designers, architects and policy makers whether they solely trust on the well-known accessibility standards to meet elderly people's expectations of healthy aging in home environments.

The findings of the study are subject to limitations. First, the generalization of the findings is critical in terms of common age-related importance-performance attributes of home environments. Furthermore, the study is based on a Turkish sample, so a cross-cultural study is needed. Moreover, the study is only focused on physical aspects of accessibility, in the future cognitive and emotional aspects of accessibility should be considered.

## References

- [1] E. Burton and L. Mitchell, *Inclusive Urban Design: Streets for Life*, Elsevier, Oxford, 2006.
- [2] N.S. Walford and S. Kurek, A comparative analysis of population ageing in urban and rural areas of England and Wales, and Poland over the last three census intervals, *Population, Space Place* **14** (2008), 365–386.
- [3] World Health Organization and the World Bank Group, *World Report on Disability*, World Health Organization, Geneva, 2011.
- [4] T.H. Dahl, International classification of functioning, disability and health: An introduction and discussion of its potential impact on rehabilitation services and research. *Journal of Rehabilitation Medicine* **34** (2002), 201–204.
- [5] S. Iwarsson, H.W. Wahl, and C. Nygren, Challenges of crossnational housing research with older persons: Lessons learned from the ENABLE-AGE Project. *European Journal of Ageing* **1** (2004), 79–88.
- [6] Y. Afacan, Designing for an aging population: Residential preferences of the Turkish elderly to age in place, In P. Langdon, P. J. Clarkson and P. Robinson (Eds.), *Designing Inclusive Futures* (pp. 241–252), Springer, London, 2008.
- [7] Y. Afacan, Elderly-friendly inclusive urban environments: Learning from Ankara, *Open House International* **38(1)** (2013), 52–62.
- [8] S. Stark, Removing environmental barriers in the homes of older adults with disabilities improves occupational performance, *Occupation, Participation and Health* **24** (2004), 32–39.
- [9] S. Iwarsson, A long-term perspective on person-environment fit and ADL dependence among older Swedish adults, *The Gerontologist* **45** (2005), 327–336.
- [10] F.M. Carp, Environment and aging, In D. Stokols & I. Altman (Eds.), *Handbook of Environmental Psychology* (pp. 330–360), Wiley, New York, 1987.
- [11] E. Kahana, A congruence model of person-environment interaction, In M. P. Lawton, P. G. Windley, & T. O. Byerts (Eds.), *Ageing and the Environment: Theoretical Approaches* (pp. 97–121), Springer, New York, 1982.

- [12] M.P. Lawton, Competence, environmental press, and the adaption of older people, In M. P. Lawton, P. G. Windley, & T. O. Byerts (Eds.), *Aging and the Environment: Theoretical Approaches* (pp. 33–59), Springer, New York, 1982.
- [13] A. Newell and A. Monk, Involving older people in design, In Coleman, R., Clarkson, J., Dong, H., Cassim, J., & Cooper, R. (Ed.) *Design for Inclusivity : A Practical Guide to Accessible Innovative and User-centred design* (pp. 111-130) (Design for Social Responsibility series), Gower, 2007.
- [14] B. Lund, *Understanding Housing Policy* (2<sup>nd</sup> ed.), The Policy Press, Bristol, 2011.
- [15] R. Jackson and C. Kochtitzky, *Creating a Healthy Environment: The Impact of the Environment on Public Health*, Centers for Disease Control and Prevention: Sprawl Watch Clearinghouse Monograph Series, 2010.
- [16] M.M. Baltes, I. Maas, H.-U. Wilms, M. Borchelt and T.D. Little, Everyday competence in old and very old age: Theoretical considerations and empirical findings. In P. B. Baltes and K. U. Mayer (Eds.), *The Berlin Aging Study* (pp. 384–402), Cambridge University Press, Cambridge, 1999.
- [17] A. Fange and S. Iwarsson, Changes in ADL dependence and aspects of usability following housing adaptation – A longitudinal perspective, *American Journal of Occupational Therapy* **59** (2005), 296–304.
- [18] R. Imrie, Universalism, Universal Design and Equitable Access to the Built Environment, *Disability and Rehabilitation* **34** (10) (2012), 873–882.
- [19] Z. Gabriel and A. Bowling, Quality of life from the perspectives of older people, *Ageing and Society* **24** (5) (2004), 675–691.
- [20] New Fair Multi-Family Housing. *A Design Primer to Assist in Understanding the Accessibility Guidelines of the Fair Housing Act*, North Carolina State University Press, North Carolina, 1999.
- [21] S.L. Handy, M.G. Boamet, R. Ewing and R.E. Killingsworth, How the Built Environment Affects Physical Activity Views from Urban Planning, *American Journal of Preventive Medicine* **23** (1) (2002), 64–73.
- [22] H-W. Wahl and G.D. Weisman, Environmental gerontology at the beginning of the new millennium: Reflections on its historical, empirical, and theoretical development, *The Gerontologist* **43** (2003), 616–627.
- [23] A. Bergland, G.B. Jarnlo and K. Laake, Predictors of falls in the elderly by location, *Aging Clinical and Experimental Research* **15**(1) (2003), 43–50.
- [24] M.L. Finlayson and E.W. Peterson, Falls, aging, and disability, *Physical Medicine and Rehabilitation Clinics of North America* **21**(2) (2010), 357–373.
- [25] United Nations, *United Nations General Assembly Rules on the Equalization of Opportunities for Persons with Disabilities Resolution 48/96*, New York, 1993.
- [26] R.L. Mace, *Universal design: housing for the lifespan of all people*, Department of Housing and Urban Affairs, Washington DC, 1988.
- [27] S. Iwarsson and B. Slaug, *Housing Enabler: An instrument for Assessing and Analysing Accessibility Problems in Housing*, Vetén & Skapen HB; Slaug Data Management, Sweden, 2001.
- [28] G. Carlsson, O. Schilling, B. Slaug, A. Fange, A. Stahl, C. Nygren and S. Iwarsson, Towards a screening tool for housing accessibility problems: a reduced version of the housing enabler. *Journal of Applied Gerontology* **28**(1) (2009), 59–80.
- [29] J. Herssens, M. Nijs and H. Froyen, Inclusive Housing (Lab) for All: a home for research, demonstration and information on Universal Design (UD). In Caltenco, Héctor; Hedvall, Per-Olof; Larsson, Andreas; Rasmus-Gröhn, Kirsten; Rydeman, Bitte (Eds.). *Universal Design 2014: Three Days of Creativity and Diversity* (pp. 185-194), Hasselt University, 2013.
- [30] The Centre for Universal Design. *Principles of Universal Design*. NC State University, 1997. Available online at [www.design.ncsu.edu/cud/univ\\_design/udprinciples.htm](http://www.design.ncsu.edu/cud/univ_design/udprinciples.htm). (June 12, 2005)
- [31] J. Martilla and J. James, Importance-performance analysis, *Journal of Marketing* **41** (1977), 77–79.
- [32] S.E. Sampson and M.J. Showalter. The performance–importance response function: observations and implications, *The Service Industry Journal* **19**(3) (1999), 1–26.
- [33] M.R. Evans and K. Chon, Formulating and evaluating tourism policy using importance–performance analysis, *Hospitality Education Research Journal* **13** (1989), 203–13.
- [34] F. Guadagnolo, The importance–performance analysis: An evaluation and marketing tool. *Journal of Park and Recreation Administration* **3** (1985), 13–22.
- [35] S. Alberty and B. Mihalik, The use of importance–performance analysis as an evaluative technique in adult education, *Evaluation Review* **13**(1) (1989), 33–44.
- [36] A.L. Dolinsky and R.K. Caputo, Adding a competitive dimension to importance–performance analysis: An application to traditional health care systems. *Health Care Marketing Quarterly* **8** (1991), 61–79.